# The American Journal of Surgery

EDITED BY THURSTON SCOTT WELTON, M.D.

June 1945

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Anesthesia . Pediatric Surgery

Orthopedic Surgery . Abdominal Surgery

*Fifty-fourth Year of Continuous Publication*

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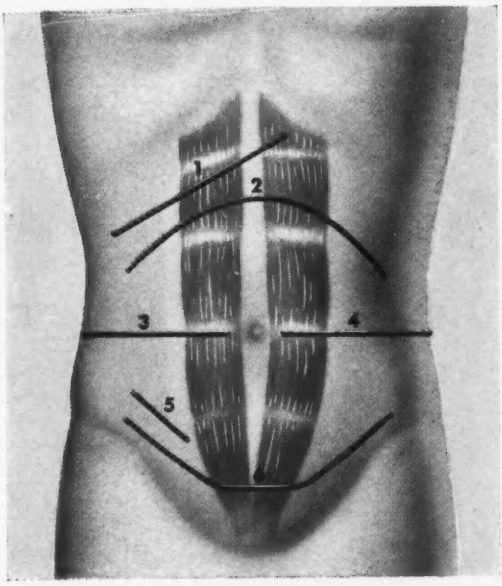


1. For gall bladder, common duct, head of pancreas.
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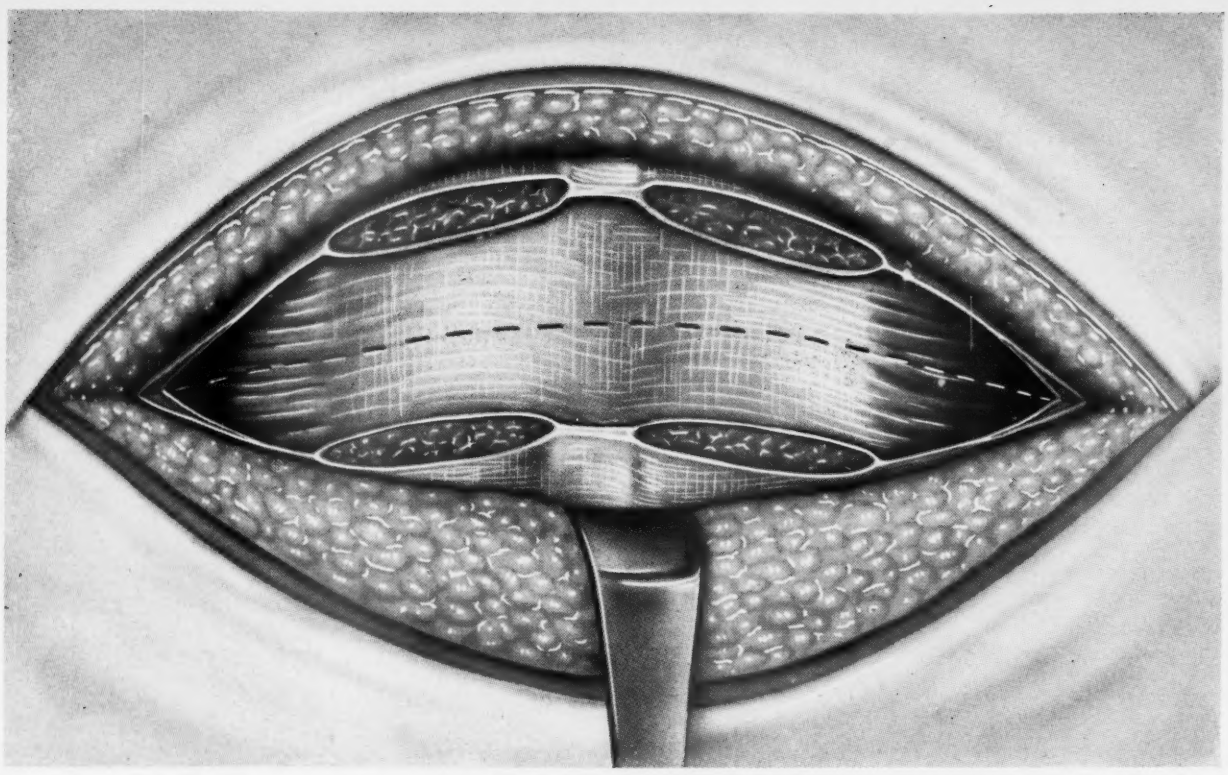

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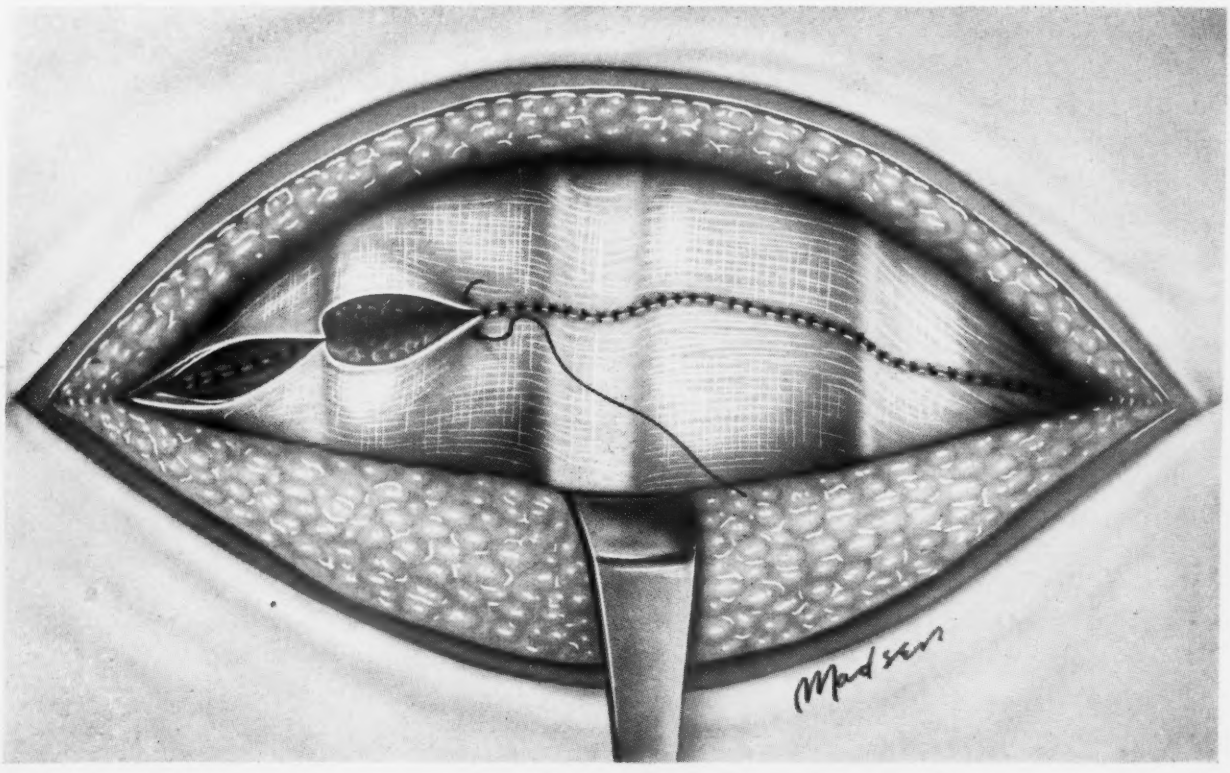

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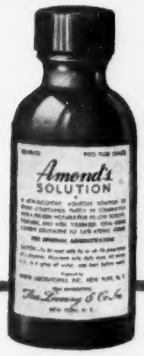


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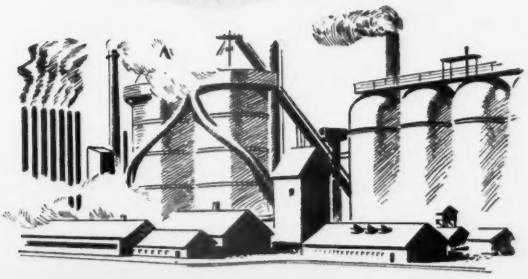

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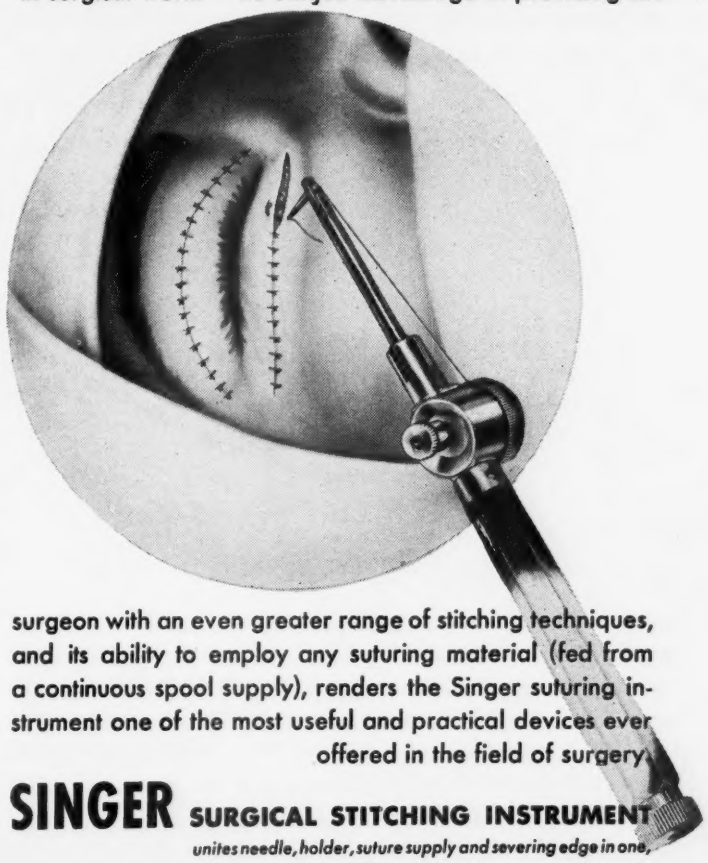

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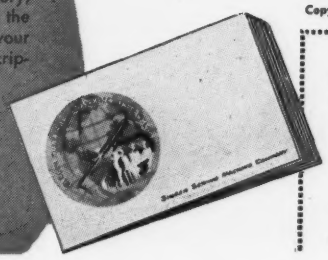

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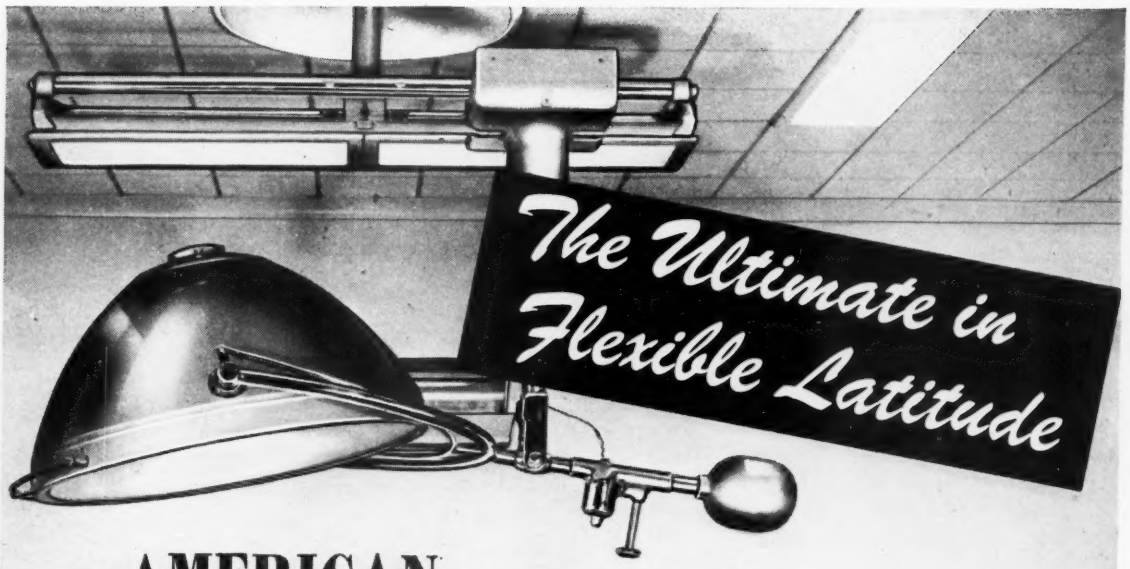


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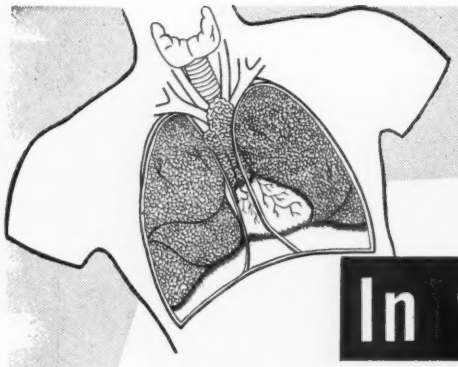

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A six year old child with bronchopneumonia complicating post-vaccination encephalitis (complete paralysis of all extremities and inability to cough) made a remarkable recovery through penicillin, 80,000 O.U. intramuscularly; paralysis disappeared after several weeks.

*Stainsby, W. J.; Foss, H. L., and Drumheller, J. F.: Clinical Experiences with Penicillin, Pennsylvania M. J. 48:119 (Nov.) 1944.*

Of special interest is the dramatic recovery of a patient with Friedlander's bacillus pneumonia, since this organism has been considered penicillin-insensitive. Patient was at point of death when penicillin was started on the 8th day of illness. Dosage 20,000 O.U. intramuscularly every 3 hours, to a total of 200,000 O.U.

*Larsen, N. P.: Observations with Penicillin, Hawaii M. J. 3:272 (July-Aug.) 1944.*

Penicillin in low dosage led to dramatic recovery from hemolytic staphylococcic pneumonia in two infants (4 and 5 weeks resp.), after failure of response to adequate doses of sulfadiazine. The 5 week old infant appeared moribund when penicillin was instituted intramuscularly. Initial dose, 5,000 O.U. followed by 1,000 O.U. every 2 hours to a total of 41,000 O.U. in 3 days. Improvement noted in 6 hours; recovery uneventful. In the 4 week old: total dosage 50,000 O.U. over 3 days; improvement apparent in 24 hours; temperature normal in 72 hours.

*McBryde, A.: Hemolytic Staphylococcus Pneumonia in Early Infancy; Response to Penicillin Therapy, Am. J. Dis. Child. 68:271 (Oct.) 1944.*

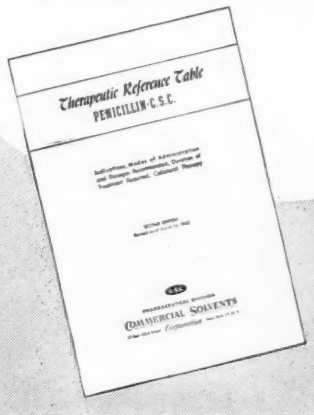
Recommendations by the Commission for the study of Pneumonia Control of the Medical Society of the State of Pennsylvania include:

Penicillin without sulfonamides as the treatment of choice in pneumonias due to staphylococci or streptococci;

Penicillin without sulfonamides in pneumonias of undetermined etiology if typical lobar consolidation is present; if the infecting organism is suspected to be the pneumococcus, streptococcus or staphylococcus; if the patient is critically ill;

Penicillin as a supplement to the sulfonamides in pneumococcic pneumonia.

*Stainsby, W. J., Chairman, Comm. for the Study of Pneumonia Control of the Medical Society of the State of Pennsylvania: Up-to-Date Facts on Pneumonia, Pennsylvania M. J. 48:266 (Dec.) 1944.*




**The Penicillin-C.S.C. Therapeutic Reference Table shows the dosages, modes of administration, and duration of therapy recommended in the conditions in which penicillin is the recognized treatment. A copy of the Second Edition, revised as of March 1st, 1945, has been mailed to every physician. If your copy has not been received, please notify us.**

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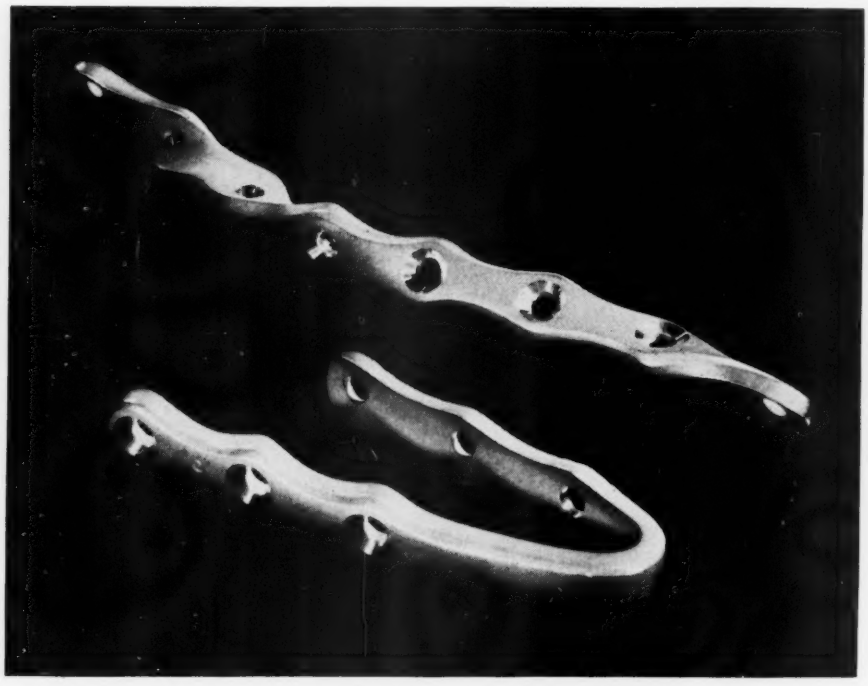

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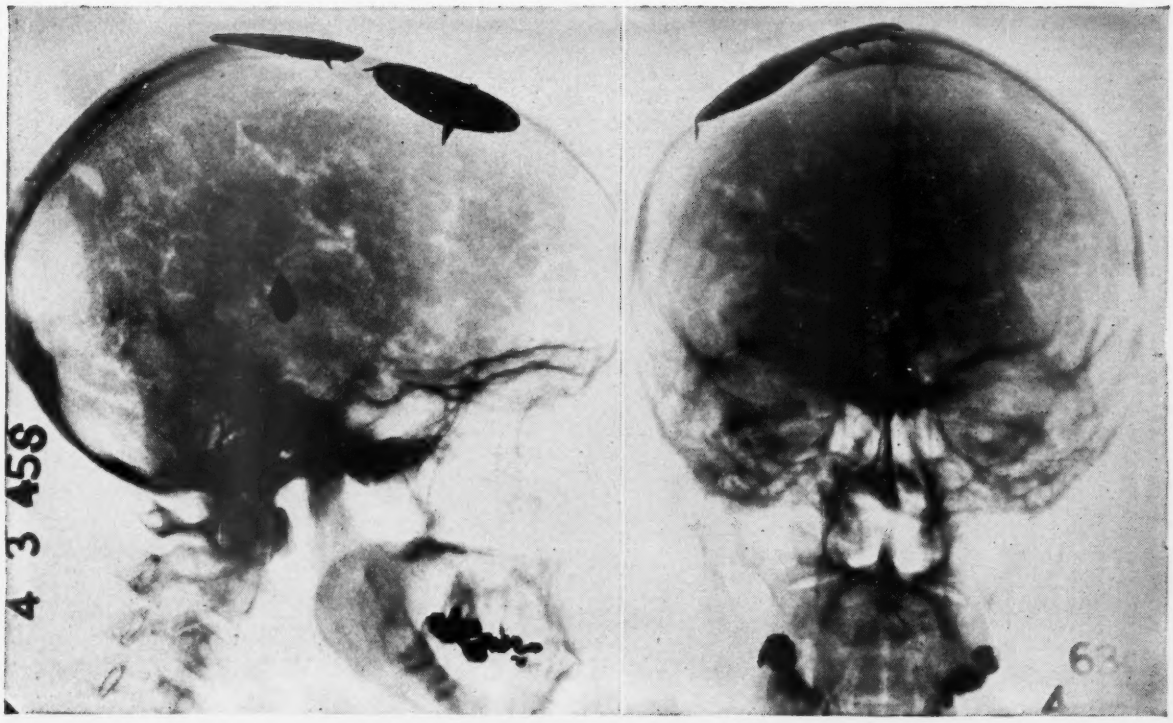


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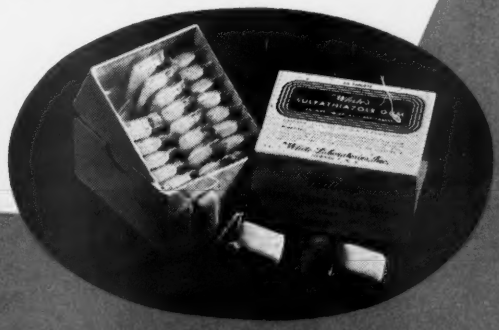

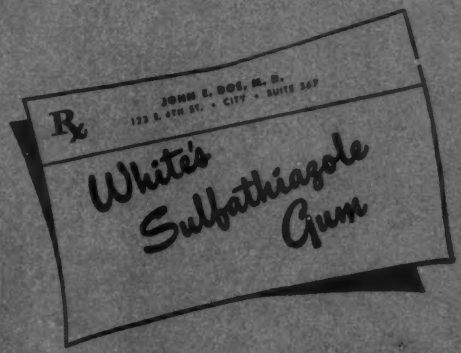


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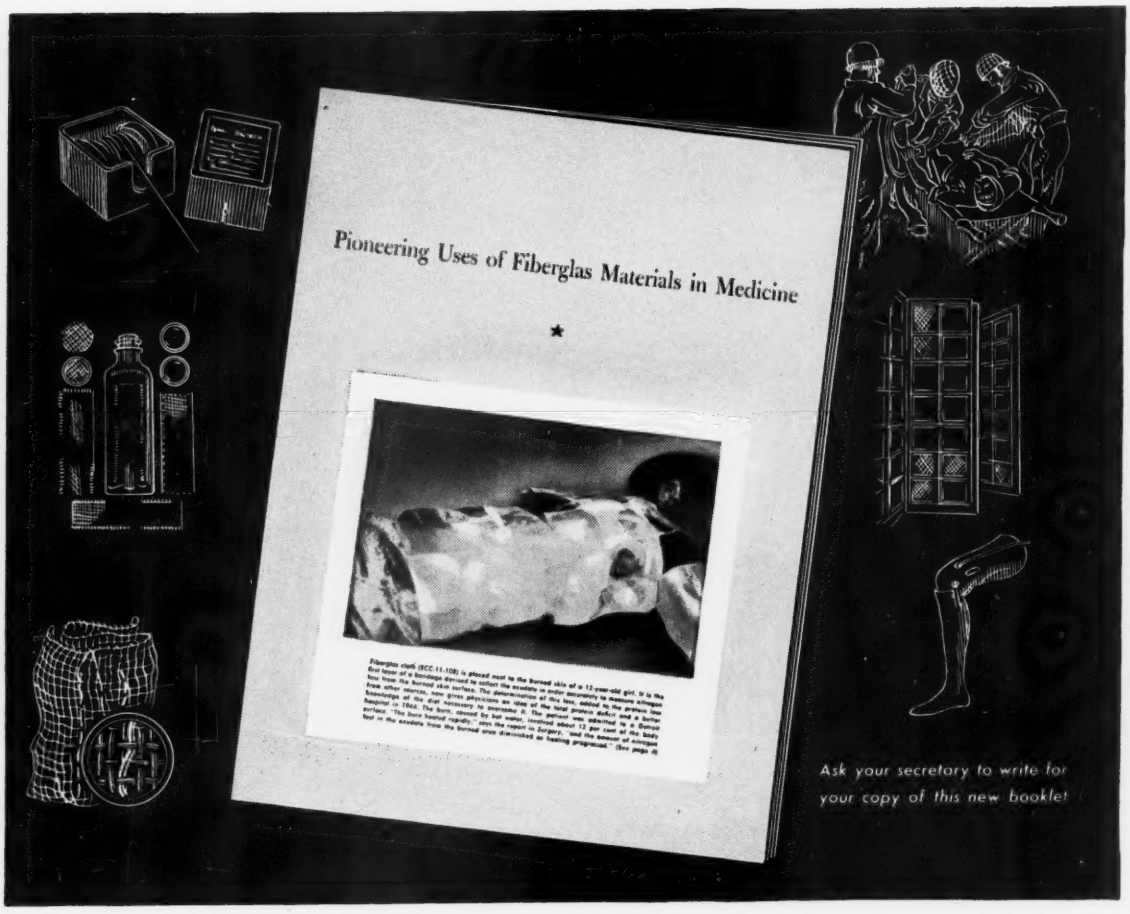


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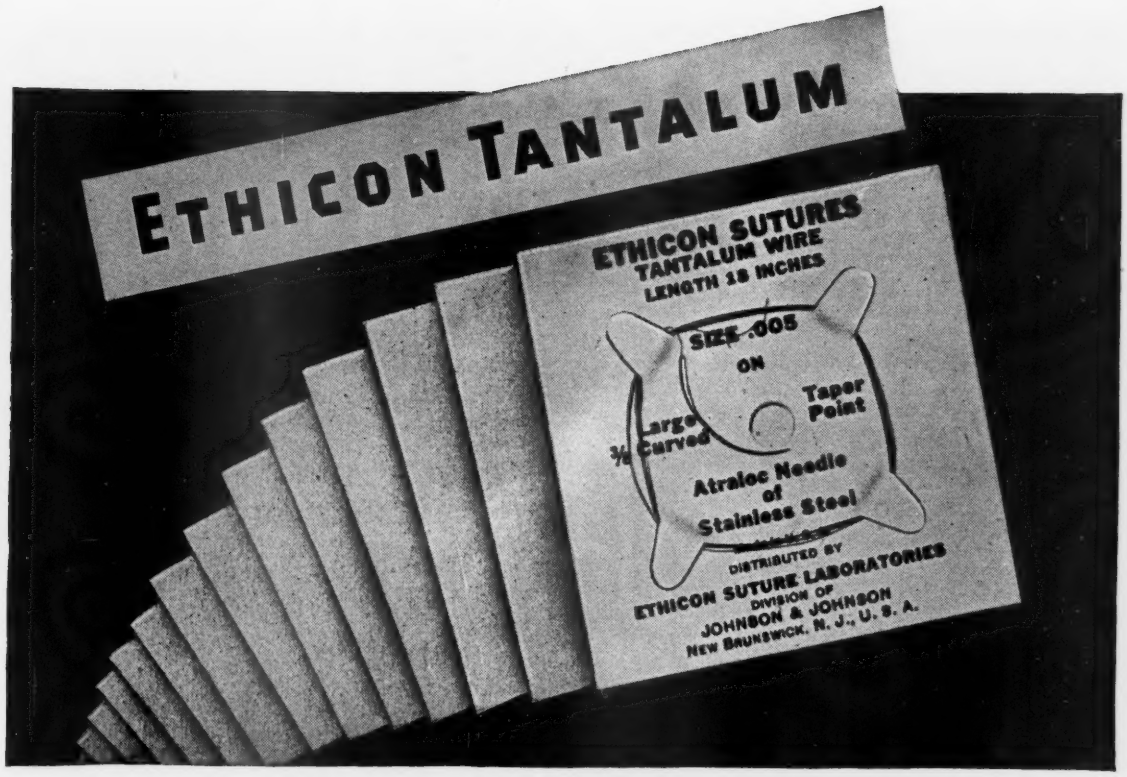


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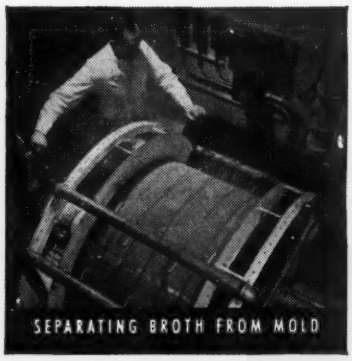
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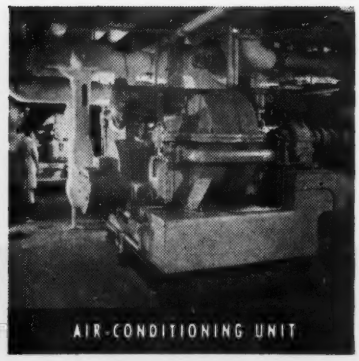
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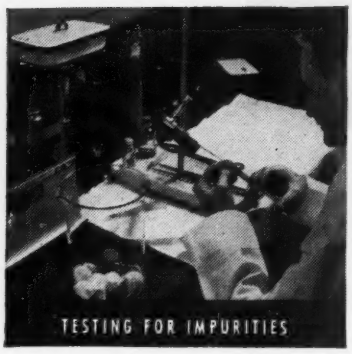
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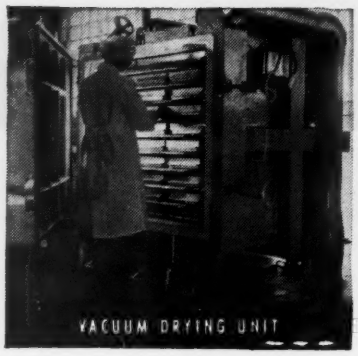
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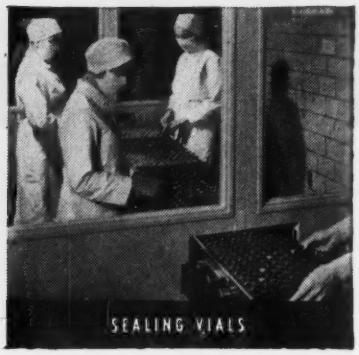
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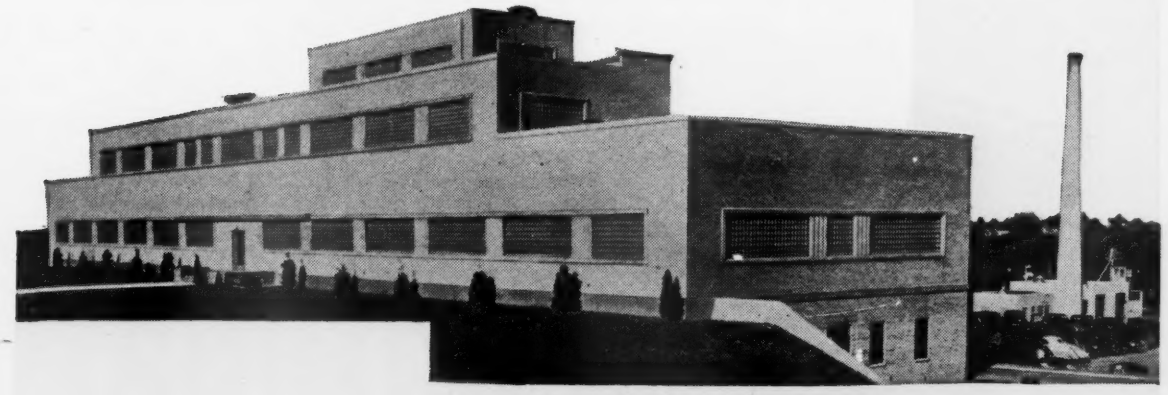

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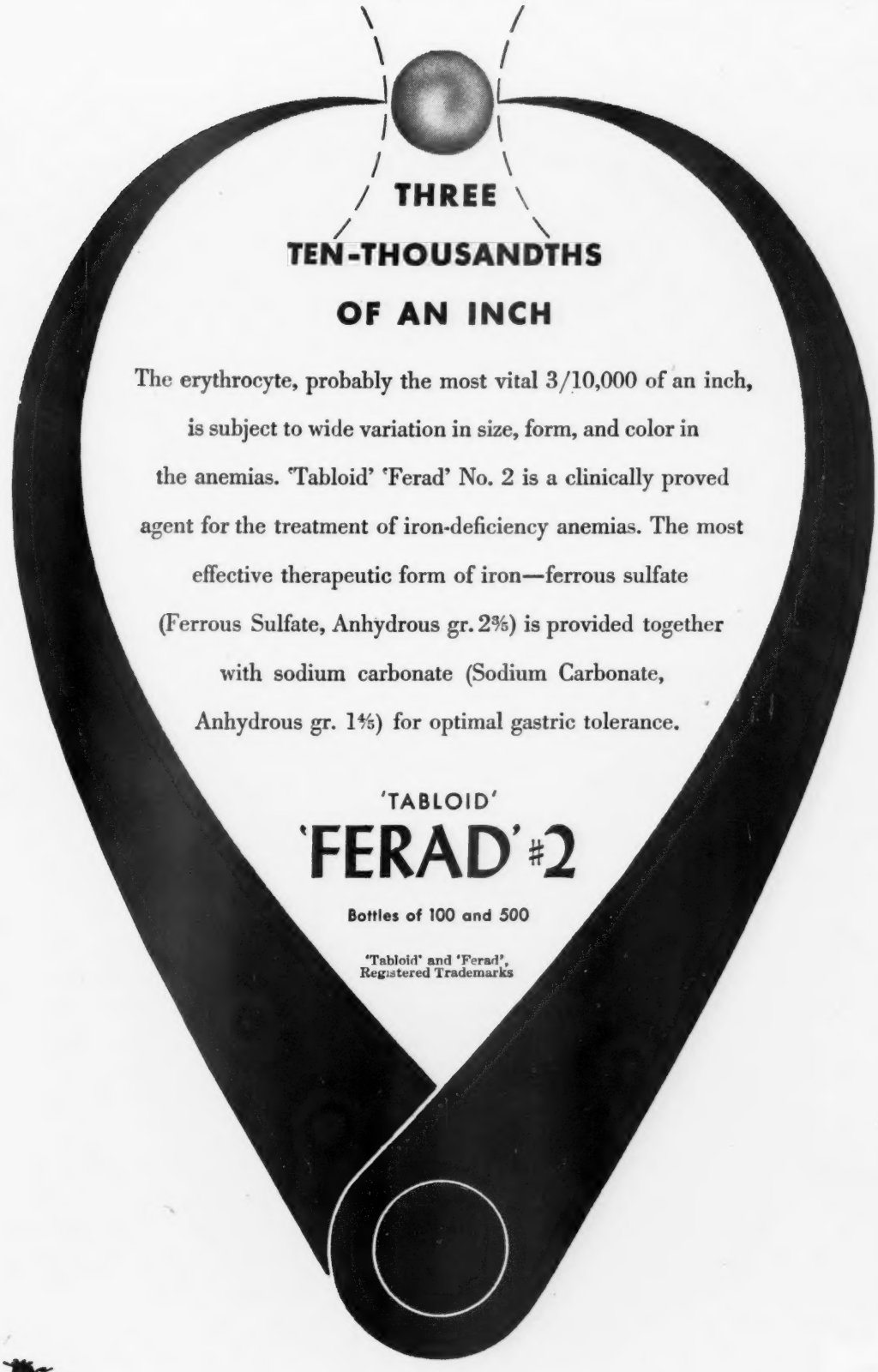

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*Kramer, G. B., and Sedwitz, S. H.: Ceepryn clinical and bacteriological studies, Am. J. Surg. 63:240-245 (Feb.) 1944.

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**Meyer, E., and Arnold, L. (1938), Amer. J. Digest. Dis., 5:418.*

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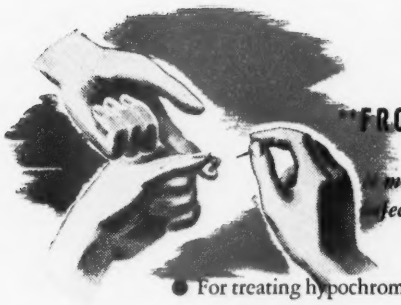

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†J. Clin. Investigation 16:547, 1937.

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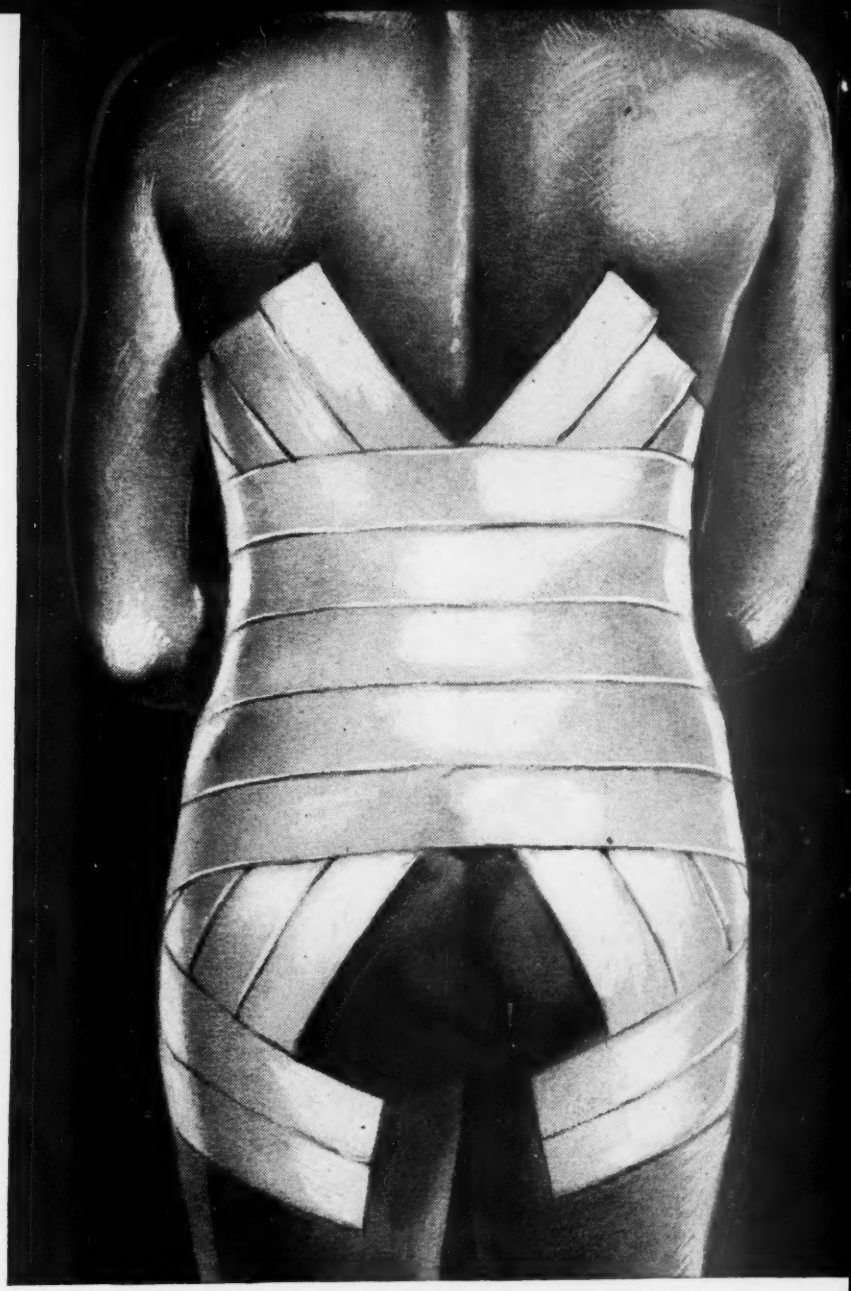

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# Editorial

## TALCUM POWDER—A GRAVE SURGICAL HAZARD

APPROXIMATELY two-thirds of a century has elapsed since the surgical world first learned of the dangers incident to the use of insoluble dusting powders; and yet surgeons have proceeded merrily in the use of these harmful substances. The reason for this seeming unconcern is not far to seek and lies in the fact that up to fairly recent times, dusting powders were used comparatively occasionally. With the advent of the use of dry gloves, talcum came into much more general use. It has been estimated that 1,000,000 pounds of it are used yearly in the United States.

The dusting powder most commonly used in surgery is talcum, a mixture of elements consisting largely of magnesium silicate. In the past, lycopodium, derived from the spores of club moss, was much more commonly used than it is today. The important factors involved in the use of both these substances is their almost complete insolubility, their tendency to set up a reactionary inflammation in whatever body tissues they find lodgment, and the consequent development of inflammatory granulomas leading to ultimate fibrosis. Such a process, set up in the peritoneal cavity, results, almost inevitably, in the development of adhesions of a firm and resisting type that, in some cases, leads to eventual intestinal obstruction. Viewed both grossly and microscopically the lesions caused by talcum may create much confusion and uncertainty. Grossly the similarity to tuberculosis may be most baffling and not infrequently the resultant granulomas are confused with malignant growths.

Nor is the peritoneal cavity the only region in mammalian anatomy that is compromised by the effects of contact with talcum powder. The brain, uterus, rectum, cervix uteri, eye, muscle, connective tissues, healing wounds and possibly other organs and tissues show equally unfavorable reactions. It has been suggested by Kronenberg that the preparation of rubber gloves with talcum, by nurses, for surgical use, be construed as a hazardous occupation and that the State of Illinois authorities take steps to control and remove the danger.

Such being the facts, we are confronted with the unusual situation that surgeons nevertheless have persisted in continuing the use of such a vicious substance as talcum powder. There has been no lack of discussion of the topic, as will be appreciated by a glance at the bibliographic references appended to the recent article by Seelig, Verda and Kidd, in the Journal of the American Medical Association for December 11, 1943. These authors outline in detail the history of this chapter in

surgery and furnish additional surgical proof of the pressing necessity for the issuance by the surgical fraternity of a "cease and desist" order that will ban talcum powder from operating rooms, wards, dressing rooms and dispensaries. Their work seems to rest on a very solid foundation of experimental data, well supporting the plea for discontinuing such a universal irritant as are the insoluble dusting powders.

It seems to be fatuous to hope that through team work, or through the practice of any reasonable precautionary measures, the evils of talcum may be side tracked. It is practically impossible to rinse it off the surface of rubber gloves and it is almost equally impossible to prevent an excess of talcum from gravitating into the finger tips of the gloves. Very careful studies have shown that gloves are inevitably torn in approximately 75 per cent of all operations, and that approximately 25 per cent of all gloves used show rents or tears.

A most interesting fact that bears on the detection of talcum in the tissues has been emphasized by German, of Cincinnati, who showed that by examining sections under polarized light the highly refractial talc crystals are detected very readily. Under ordinary illumination, these crystals may be very elusive. German was able to show that talcum crystals were present in 84 per cent of the abdominal cavities of a series of patients who had been subjected to laparotomy.

Seelig and his co-workers have found that potassium bitartrate, properly used, serves as a fairly satisfactory substitute for talcum and they furnish their reasons for this recommendation. Reading between the lines of their first contribution to the subject, one gathers that the problem is not yet solved with complete satisfaction; but that the search has not yet ended. Studies are continuing with a specially prepared starch. This new starch does not gel on boiling or autoclaving, is ideal in its physical properties, and is attacked by the diastase in the body fluids with such astounding rapidity that within a few hours it is completely absorbed from the body cavities and from the body tissues. More important than all this is the fact that it is a bland powder that the body tolerates with no perceptible tissue reaction. This powder is not yet on the market because of manufacturing restrictions imposed by the war. But the scene is all set for the final undoing of talcum, with the consequent release of surgeons from fear of postoperative complications due to its use.

M. G. S.

# Original Articles

## AIR EMBOLISM*

### WITH SPECIAL REFERENCE TO ITS SURGICAL IMPORTANCE

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MOST surgeons regard *air* and *fat embolism* as more or less nebulous entities, which are rarely serious enough to cause concern. Both these conditions occur, however, more frequently than is suspected, and fatalities are occasionally encountered. These deaths are usually sudden but may at times be somewhat protracted.

The author, therefore, believes that the type of case in which *fatal air embolism* may occur should be emphasized, and the clinical symptoms and pathological findings reviewed.

Air embolism is the result of the entrance of air into the venous circulation (or occasionally the systemic circulation), with consequent blockage of the right side of the heart and the pulmonary circulation, or the cerebral or coronary circulations. Blockade of vessels in other locations are of no practical significance, since no disastrous results ensue.

For air embolism to produce death, air must enter the circulation in *large quantities* in a *short period of time*. Even large quantities of air may enter the circulation over a long period of time without fatal results. For instance, a liter of oxygen has been injected into man in the course of an hour without serious injury. Of course oxygen is more readily absorbed than air which contains only 21 per cent oxygen.

Small quantities of air rarely produce death unless the air is trapped in the coronary arteries or in some vital cerebral location.

There are *two main varieties* of air embolism: *Pulmonary embolism* which is much more frequent and important, and *systemic embolism*.

#### FATAL PULMONARY AIR EMBOLISM

When a large volume of air reaches the right side of the heat in a short period of time, foamy blood containing large bubbles of air is formed. This is more compressible than normal blood and less readily expelled, a considerable amount of air remaining after each systole. Thus, the pulmonary circulation becomes obstructed, the right auricle and ventricle are distended and tympanitic, the peripheral venous pressure is increased and sudden death occurs due to interference with proper ventricular contraction. (Fig. 1.)

*Symptoms.* Shortly after the onset, the patient becomes dyspnoeic, cyanotic and pulseless. Death usually occurs in a few minutes. The clinical mode of death is similar to that observed in massive pulmonary embolism, such as occurs after thrombosis of the veins of the lower extremity. There is an "acute cor pulmonale."

*Autopsy Findings.* Air embolism of this type can often be suspected from the history of the case and the conditions under which death has occurred. No death from

* From the Office of the Chief Medical Examiner of Essex County, Newark, N. J.; the Department of Pathology of the Newark City Hospital; and the Department of Forensic Medicine, New York University College of Medicine.

air embolism, however, is proved unless proper autopsy technic is used for its demonstration. Two methods are in use:

(1) After opening the chest and abdominal cavities, all great vessels are ligated, including the inferior vena cava and the lungs and heart removed *en masse*. They are then immersed in a basin of water and the right ventricle incised. Air bubbles escape if air embolism is present.

In routine medicolegal autopsies, I have opposed any autopsy technic in which organs are removed *en masse*. The organs are pulled and dragged out, artefacts are common, and important evidence is often missed or destroyed.*

(2) For the above reasons I prefer the original Virchow autopsy technic, in which nothing is disturbed until it has thoroughly been investigated, and the organs are removed in a logical and methodical manner Thus, in the demonstration of air embolism, the abdomen and chest are carefully exposed. The sternoclavicular joints and the cartilages of the first two ribs are not disturbed for fear of cutting the vessels of the upper chest and the lower two-thirds of the sternum removed without undue force. The pericardium is opened and the heart exposed.

In the pulmonary type of air embolism, the right side of the heart will be found distended, often ballooned out and tympanitic on percussion. The inferior and superior vena cavae will be distended with what appears to be frothy blood. Then, the pericardium, chest and abdominal cavities are filled with water. The heart often shows a tendency to rise to the surface. It is held back below the surface of the water and the right ventricle is then incised. In pulmonary air embolism large bubbles of air and frothy, foamy blood escapes. The inferior vena cava may then be punctured under water.

* The "en masse" autopsy technic, often called the Le Count method, is very popular in this country. In general, I believe its use, as a routine procedure, is very apt to lead to careless and incomplete autopsies. It has some special advantages, however, which are limited.

It is important that the autopsy be performed as soon as possible after death, so that air embolism is not confused with the gases of decomposition. There should be no visible signs of such decomposition, i.e., no hemolysis in the blood or reddish staining of the endocardium or intima of the veins.

### FATAL SYSTEMATIC AIR EMBOLISM

In a few cases, air may enter the left side of the heart in the form of foamy, frothy blood containing small air bubbles. Systemic air embolism results. As a rule the air is rapidly absorbed producing little or no symptoms unless it reaches the brain in considerable amounts or is caught in the coronary circulation. The effect of air in other organs is negligible.

In most of these cases the air has originally entered the venous circulation resulting in pulmonary air embolism. Death, however, has not occurred and small amounts of air in the form of fine bubbles have passed through the lungs or through a patent foramen ovale into the left side of the heart.

Though a patent foramen is found in 25 per cent of individuals, the opening is usually small and physiologically closed by the higher pressure in the left auricle. However, in shock, when the pressure in the right side of the heart may approach that in the left side, paradoxical embolism may occur.

Air may also enter directly into the left side of the heart from injury to a pulmonary vein without entering the venous circulation. This may occur during artificial pneumothorax.

In addition, air may enter the vertebral system of veins and pass directly to the brain, by-passing the heart. Such embolism may occur in air insufflation around the adrenals for their roentgenographic visualization.

*Cerebral Air Embolism.* Usually if considerable air reaches the left side of the heart, the brain is likely to receive most of it. Cerebral air embolism is charac-

terized by usually a *slow mode of death.* The patient lives a few days as a rule in a maniacal, stuporous or comatose condition.

The characteristic autopsy findings in such cases are *multiple petechial hemorrhages* throughout the white matter of the brain. These must be differentiated from similar appearing hemorrhages encountered in fat embolism, and from concussion hemorrhages in blunt force injuries to the brain and the various forms of hemorrhagic encephalitis.

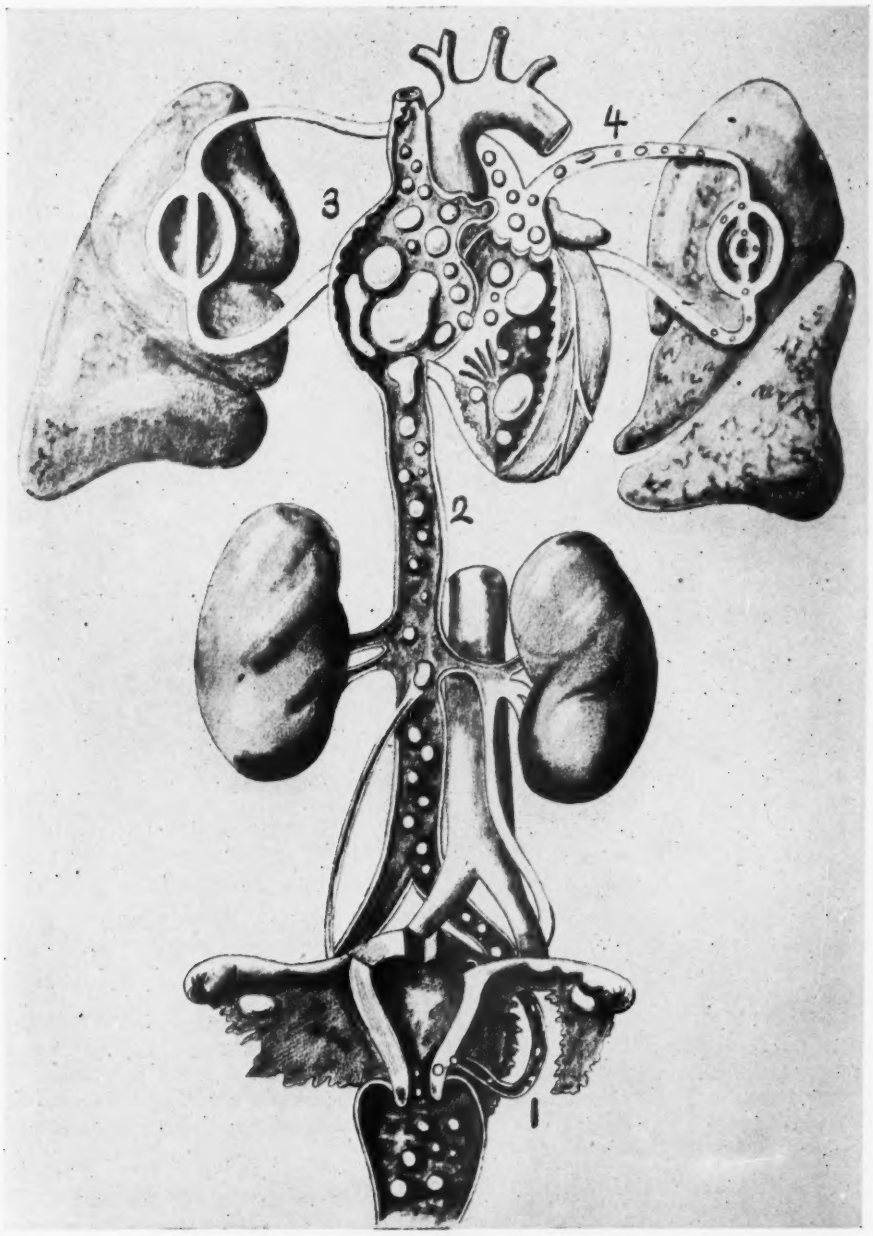


Fig. 1. Fatal air embolism of the pulmonary type. (1) Entrance of air into uterine veins; (2) air in inferior vena cava; (3) right side of heart distended with foamy blood and large air bubbles preventing proper systoles; and (4) foamy blood containing smaller air bubbles entering pulmonary circulation. Case of sudden death following intravaginal powder insufflation for treatment of pruritus.

Air bubbles in the veins of the leptomeninges are usually an artefact occurring in the routine removal of the brain and are of no significance.

*Coronary Air Embolism.* Should the coronary circulation be blocked by air, sudden death results. This is difficult to prove at autopsy, since air bubbles are frequently sucked in during routine removal of the heart. The anatomical pathways in air embolism of the systemic variety is shown in Figure 2.

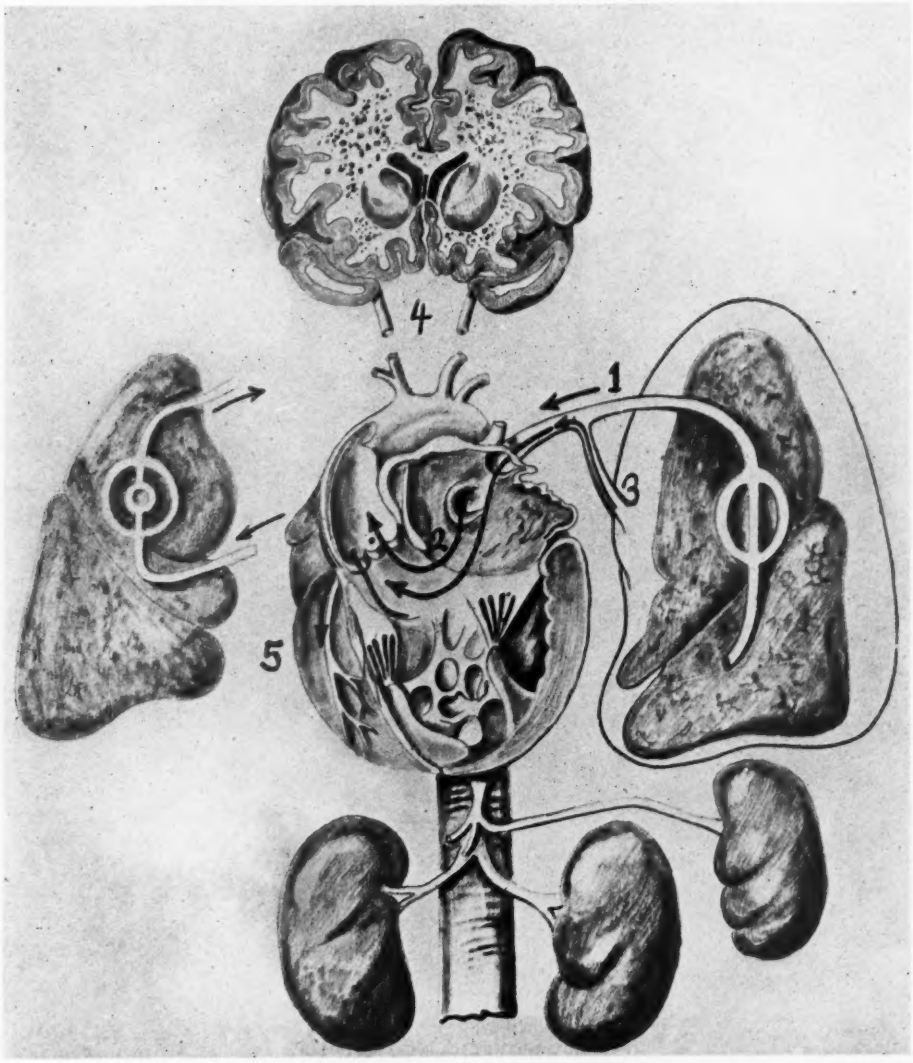


FIG. 2. Fatal air embolism of the systemic type. Note air entering the left side of the heart (1) from lungs, (2) through patent foramen, and (3) through pulmonary vein injured during artificial pneumothorax; (4) cerebral air embolism with multiple hemorrhages in white matter; (5) coronary air embolism.

### VARIOUS CONDITIONS IN WHICH FATAL AIR EMBOLISM MAY OCCUR

*Fatal air embolism* is almost always of the *pulmonary type.* In the experience of the medical examiner, both pulmonary and systemic air embolism has been observed under a variety of conditions. They may be briefly discussed as follows:

*Head.* Wounds or operations in which the dural sinuses are injured may cause air embolism. The walls of these sinuses are stiff, therefore, do not collapse easily and favor the entrance of air.

*Lavage of the Nasal Sinuses,* especially the antra Highmori, has been followed by immediate death. The author knows of three sudden deaths in clinics and physician's offices from this procedure.

Air under considerable pressure (often five to ten pounds) is blown through the antrum to replace the irrigating fluid. Great care should be taken to control this pressure. Often in office buildings, compressed air is piped to individual offices, and is not regulated by pressure gauges or reducing valves. Pressures may vary and reach dangerous amounts.

*Neck and Upper Chest.* Wounds and operations in the region of the carotid vessels may cause air embolism. This is particularly true when the jugular vein is injured, during thyroid operations, in the removal of tumors of the neck, in the repair of arteriovenous aneurysms, et cetera. The surgeon may notice a hissing sound or "soufflement" as air is sucked in. Death may quickly follow as the right side of the heart is rapidly filled with air.

Any type of wound or operation in the neck or upper chest which cuts or penetrates large veins of the neck or mediastinum may be complicated by air embolism. Sometimes the air may enter the left side of the heart from injury to a pulmonary vein.

*Peripheral Veins.* Seldom is any large amount of air injected in the peripheral veins. Small amounts frequently enter in various intravenous injections but rarely produce symptoms.

Fatal air embolism, however, has been observed after continuous intravenous injections, especially when tubing has slipped and becomes disconnected and air is sucked in for several minutes.

In blood donations, using closed types of apparatus, air has been forced into veins of donor or recipient, by unwittingly connecting the positive pressure tube to the individual, with resultant serious reaction.

*Urinary Bladder.* Air embolism has occurred after injections of air into the urinary bladder for the purpose of taking aerograms or for operative or therapeutic purposes. Ulceration of the bladder favors the entrance of air.

*Uterus.* Fatal air embolism is, however, most frequent after injection of air into the uterine cavity.

*Criminal Abortions* are the most frequent cause of fatal air embolism. It usually occurs in dirty abortions, often performed by midwives using the old Hungarian syringe method of injecting soap-suds and air directly into the uterine cavity. Such fatalities are sometimes accompanied by fat or oil embolism. The placenta is often torn and partially separated allowing large quantities of air to rush into maternal sinuses and uterine veins.

*Obstetrical Cases* have been complicated by air embolism, especially at the delivery of cases of placenta previa.

*Diagnostic and Therapeutic Uterine Injections* have been followed by air embolism, with occasional fatal results. In testing the patency of the Fallopian tubes (Rubin test), physicians have occasionally observed sudden collapse and even convulsions, from which, fortunately, the patients have recovered. Fatal air embolism has occurred. The air injections should be carefully controlled and pressures not exceeding 150 mm. of Hg. should be used. Some physicians have been using dangerous pressures of 200 mm. or more.

*Intravaginal Insufflations* for the treatment of trichomonas infections and pruritus have caused sudden death from pulmonary air embolism.* In these procedures the vagina is intentionally distended with air so that its folds will be smoothed out, allowing medicinal powder to cover its walls.

*Transuterine Pneumoperitoneum* for pneumoroentgenographic diagnosis could easily be complicated by air embolism, especially if attempted near a menstrual period, or after uterine curettage.

*Peritoneum. Direct Pneumoroentgenography* is usually not considered to be a dangerous procedure. However, the puncture of a large intra-abdominal vein could result in air embolism. If the vertebral system of veins were injured, air might

* MARTLAND, HARRISON S. Fatal air embolism due to powder insufflators used in gynecological treatments. *Am. J. Surg.*, 68: 164, 1945.

by-pass the heart and go directly to the brain, resulting in systemic air embolism of the cerebral type.

*Pleura. Artificial Pneumothoraces* are often complicated by air embolism but death rarely results, and recovery is followered by no sequellae. In some one in every 500 or 1,000 artificial pneumothoraces the patient may suddenly feel queer, often go into temporary shock and even have a convulsion. In the rare fatal case, air embolism has been reported, the air gaining access to the systemic circulation through an injured pulmonary vein. Some authorities, however, do not believe that these reactions are due to air embolism and attribute them to some unexplained pleural-cardio-inhibitory reflex.

As these deaths are said to be sudden, and as sudden death from cerebral or coronary air embolism is difficult to prove at autopsy, I am of the opinion that the cause of death in these cases is still controversial.

*Retroperitoneum.* Air insufflations in the region of adrenal glands for the roentgenographic visualization of adrenal tumors, etc., have been followed by death said to have been due to air embolism. It is possible in this procedure to injure vertebral veins and have direct cerebral air embolism.

## CONCLUSIONS

1. The various conditions in which *air embolism* may occur have been discussed. Most of these are mainly of surgical interest. The introduction of air under pressure into the uterine cavity is the commonest cause of air embolism.

2. Air embolism is not often a serious complication, and gives rise to little or no symptomatology whatsoever. Reactions which are sometimes alarming, such as collapse, shock and even convulsions, may occur but these are often recoverable leaving no sequellae.

3. Fatalities occasionally are encountered. The common type of *fatal air embolism* is the *pulmonary type.* In this form large quantities of air reach the right side of the heart in a short period of time and interfere with proper ventricular systoles and results in sudden asphyxial death.

4. A less common form of *fatal air embolism* is the *systematic variety* in which *cerebral air embolism* is the most important. Deaths in these instances are protracted, sometimes taking two to five days, during which the patient is maniacal, stuporous or comatose. The characteristic pathological lesions are multiple, petechial hemorrhages in the white matter of the brain.

In rare instances *coronary air embolism* causes sudden death. This is difficult to prove at autopsy and many cases in literature would not bear critical analysis.

5. Greater care should be used in the various diagnostic and therapeutic procedures which depend upon the introduction of air under pressure into the vagina, uterus, urinary bladder, peritoneum and perinephric space in order to prevent such catastrophies.

Precautions should be taken in operations around the large veins of the neck, upper chest, mediastinum and dural sinuses to prevent air embolism as a complication. And the possibility of air embolism in gunshot wounds, stab wounds and cuts in these locations should be borne in mind.

# HERNIA IN INFANCY AND CHILDHOOD

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A CONGENITAL inguinal hernia is one wherein an abdominal organ, an associated structure or both descend into a partly, or completely, open processus vaginalis peritonei.

## ETIOLOGY

*Predisposing Factors;* 1. *Heredity.* Heredity appears to play a distinct rôle. Kingdon, many years ago, recorded a 34 per cent ratio, which is too low. Astley Cooper stated that hereditary factors were of indubitable importance in the incidence of hernia.

The statistics of our day are to the general effect that the hereditary basis accounts for at least 25 per cent of all varieties of hernia, especially in infants and older children. Birkenfeld (*Arch. f. klin. Chir.*, 1930) wrote that the familial congenital predisposition in men is four times greater than in women.

A significant fact, obvious from world-wide data, is that about one male adult in 500 on examination reveals a maldescended testicle. This developmental "fault" runs in families.

It has likewise been shown that there are hereditable abdominal muscle anomalies (due to endocrine dysfunction) which predispose to hernias of all varieties. (Fig. 1.)

When the testicle descends from its embryonic retroperitoneal position it carries peritoneum along with it through the inguinal canal and into the scrotum. The potential sac thus formed, the processus vaginalis, becomes obliterated (sometimes prenatally) through its entire extent, with the exception of the part which envelops the testicle. This portion is the tunica vaginalis. The part which parallels the spermatic cord is the funicular process which, under normal conditions, closes throughout its extent. If this does not occur antenatally, a direct communication remains from the peritoneal cavity to the testicle, permitting the abdominal viscera or associated structures to descend into the scrotum. When the lumen of the funicular process is obliterated, only its initial part, the portion persisting, the proximal end, permits the ingress of a funicular hernia. This is the most common congenital variety.

When the lumen of the funicular process is obliterated in its proximal extent, fluid may accumulate in the distal portion of the process and in the tunica vaginalis of the testis forming a hydrocele. The lumen of the process may be obliterated at each end, but remain open somewhere in its extent. When fluid accumulates here, it forms a hydrocele of the spermatic cord. (Figs. 2 and 3.)

During the ninth month, after the descent of the testis has been completed, the processus vaginalis is occluded in two situations, at the anulus inguinalis profundus and immediately above the testis; the intervening part normally becomes obliterated. A patent process which communicates with the abdominal cavity is the basic, etiologic factor in the development of inguinal hernia, congenital or acquired. A patency between the two sites of obliteration is the predisposing factor of a hydrocele of the spermatic cord. (Figs. 4 to 11.)

2. *Sex.* The preponderant incidence of indirect inguinal hernia in males is due to many embryologic, as well as anatomic factors, to wit: (1) The greater incidence of an imperfectly closed processus vaginalis in men than in women. (2) the descent of the testicle, and (3) the requirement for

a larger aperture for the exit of the spermatic cord. In the early years of life the inguinal region area, among other peculiari-

The importance of these factors is greatest in the newborn child. In a large proportion of infants, indubitably the

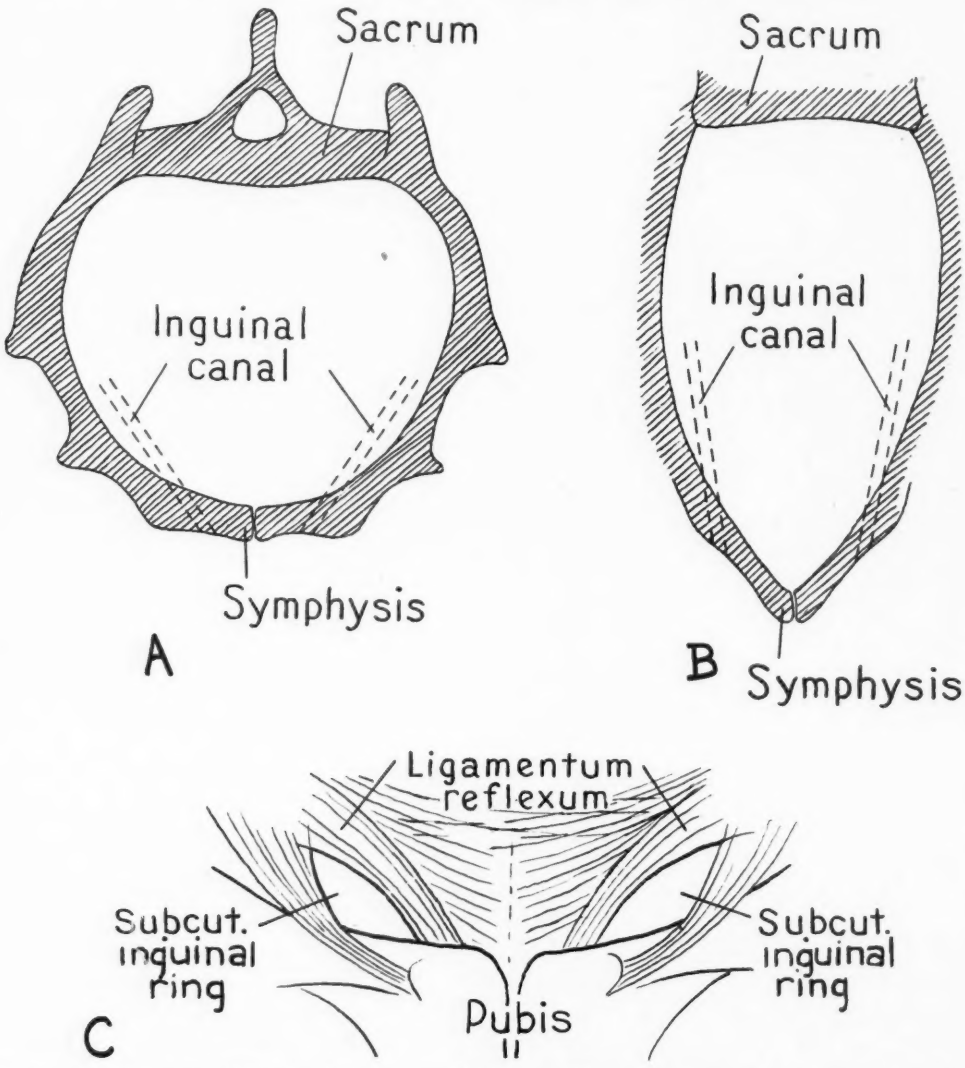


Fig. 1. Man's susceptibility to hernia caused by the orthograde posture is overcome by the visceral support and the obliquity of the inguinal canals. A, the form of pelvis and inguinal canal in man; B, the corresponding forms in pronograde primates (from Keith's Human Embryology and Morphology); C, ligamentum reflexum.

ties, presents not only a short inguinal canal with the anulus inguinalis profundus directly opposite the anulus inguinalis subcutaneous, but also defects due to maldescent of the testis and of non-obliteration, or obliteration in part, of the tunica vaginalis.

*Secondary Etiologic Factors.* Factors which increase intra-abdominal pressure, excessive crying, constipation, straining, phimosis and coughing, are frequent secondary etiologic factors.

closure of the processus vaginalis, incomplete at birth, finally occurs when they are a few months old. During the interval any unusual increase of intra-abdominal pressure favors the development of a congenital inguinal hernia.

## Pathology of Inguinal Hernia in Infancy and Childhood

In infants and older children the vast majority of hernias are of the oblique variety. The minority reveal other varie-

ties, usually with one or more of the following associated conditions: (1) Extroversion of the bladder, complicated by

*Contents of the Hernial Sac.* The small intestine is the most frequent content of the sac. Omental contents are uncommon in

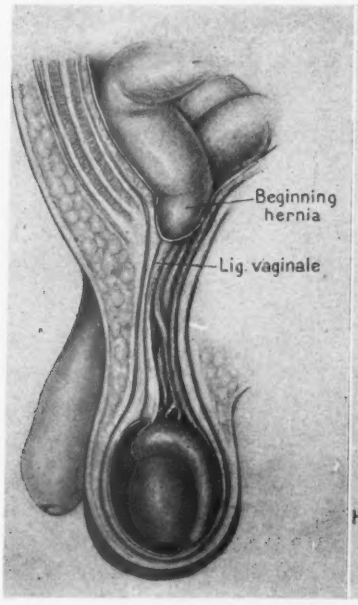


Fig. 2. An early stage in the formation of an indirect inguinal hernia.

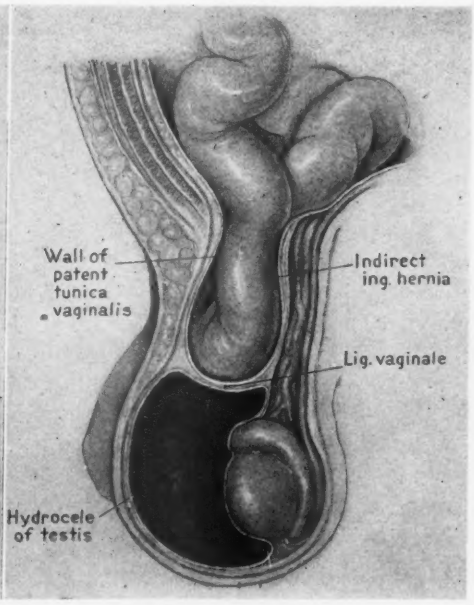


Fig. 3. Indirect inguinal hernia with hydrocele of the testis.

direct inguinal hernia, (2) undescended testis, with an inguinal hernia, in which the sac is properietal, and (3) ectopia testis, in which the hernial sac may trail the aberrant testis.

*Congenital Inguinal Hernias.* In this variety the hernial sac leaves the abdomen, with the various structures of the spermatic cord, and passes through the abdominal wall along the inguinal canal, appearing on the surface through the subcutaneous ring. In this group are the following sub-groups: (1) Bubonocele; so-called because the sac is commonly found at the usual site of buboes—an incomplete hernia confined to region of the anulus inguinalis profundus; (2) inguinal; the protrusion is lodged completely or partly within the inguinal canal. The tunica vaginalis of the testis does not communicate with the patent tunica vaginalis of the hernia; (3) scrotal; the hernia passes through the anulus inguinalis subcutaneous and fills part or all of the scrotal sac. There is a continuity of the lumina of both the testicular and cord tunicae.

children because at an early age the omentum has not reached the degree of development which it assumes in later life.

## COMPONENTS OF INGUINAL HERNIAS AND THEIR RELATIONS

*Relations of an Inguinal Hernia.* The relation of the spermatic cord to the neck of the hernial sac is of prime importance. It usually lies posterior, lateral and below the sac, but it may spread out upon it, the vas deferens being always medial and the vessels lateral. The protrusion sometimes appears to have passed directly through the tissues of the spermatic cord, separating the vas from the vessels. (In direct hernia the cord is not infrequently found spread over the surface of the sac.)

The relations of the testicle to the hernial sac are variable. In acquired hernia it is usually found below and in the congenital, it lies at the lower portion of the sac.

*Components of an Inguinal Hernia.* The components of a complete inguinal hernia are:

*The Sac:*
- *Mouth;* the path between the lumen of the sac and the abdominal cavity.
- Neck; the narrow section between the mouth and body of the sac.
- Body; the portion lying beyond the neck.

*The Contents:*
1. Omentum
2. Intestine
3. Other viscera or parts thereof
4. Fluid
5. Various loose bodies

*The Coverings of the Sac*

*Hernial Coverings and Sac or Sacs.* The immediate covering of the structures contained in the hernia is called the hernial sac.

An oblique inguinal hernia, whether congenital or acquired, possesses the same coverings as the spermatic cord.

A direct inguinal hernia (Hesselbach's hernia), if it finds exit through the medial inguinal fossa between the plicae epigastrica and hypogastrica, pushes ahead its own covering of transversalis fascia, in place of the ready made tunica vaginalis testis et funiculi spermatica. If it egresses through the internal or supravesical fascia between the plicae urachi and hypogastrica, it must protrude in front of it not only the transversalis fascia, but the edge of the tendo conjunctus likewise, the latter taking the place of the cremasteric covering.

The sac lies in the middle of the cord, surrounded by its various coverings, the veins resting on its anterolateral aspect, while the vas deferens with its artery lies on the posteromedian surface.

At the upper extremity of the cord a pedunculated collection of fat is often present, especially in young stout babies. The bladder wall sometimes lies in close relationship with it.

*Disposition of the Sac.* The disposition of the sac in a congenital inguinal hernia may follow one of four courses: (1) the vaginal; (2) the funicular; (3) the retrofunicular; (4) the intrafunicular. (Figs. 12, 13 and 14.)

*Symptoms.* In certain cases the hernia is noticeable at birth. In the majority, however, the hernia appears during the second or third month. It reduces easily.

The large hernia which contains a quantity of small intestine and possibly the cecum or sigmoid loop is often associated with signs of intestinal derangement.

DIAGNOSIS

*Physical Examination.* It is important that a definite routine be followed in the examination of every hernia, whether in infancy or later life. Investigation begins with an examination of the testes—whether they are in their normal position—completely descended. Anorchism is extremely rare. The spermatic cord should then be examined. The finger is passed along the whole length of the spermatic cord and it may be possible to delimit the lower end of a funicular sac. (It is usually possible to diagnose the condition without inserting the finger into the inguinal canal.)

The inguinal rings should be examined, if necessary. A patulous ring is suggestive of the presence of a hernia. (Fig. 15.)

*Inspection.* There is rarely much difficulty in making a diagnosis. On gentle pressure from below a reducible swelling will be found which passes from above downward and makes its appearance on the surface through the subcutaneous inguinal ring. It is unlikely to be anything other than a hernia. When it is reduced, the groin should be further examined for possible associated conditions, e.g., inguinal adenitis, iliac adenitis, or hydrocele of the spermatic cord.

If the hernia is incarcerated, a tender mass, flattened, will usually be palpable within the inguinal canal or in the scrotum on the corresponding side. The infant, or an older child, cries continuously and is in evident distress. If the incarceration is of few hours' duration, there is more or less constant vomiting, abdominal distention and borborygmi.

FIG. 4. FIG. 5.

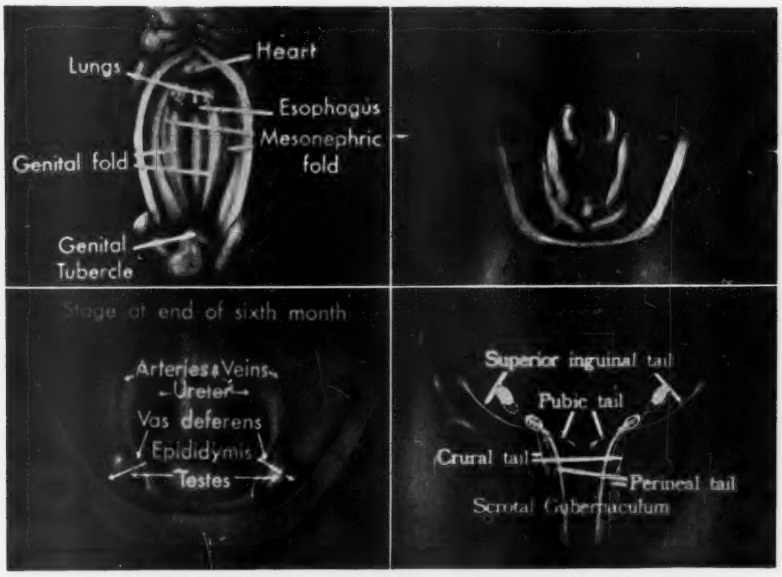


FIG. 6. FIG. 7.

FIG. 4. Condensation of embryonal mesoderm.
FIG. 5. Anlage of testis; testis beginning to lose its elongated form.
FIG. 6. Testis, globular in form, just before descent through inguinal canal.
FIG. 7. Gubernacula "guiding" the testis to its normal and abnormal habitats.

FIG. 8. FIG. 9.

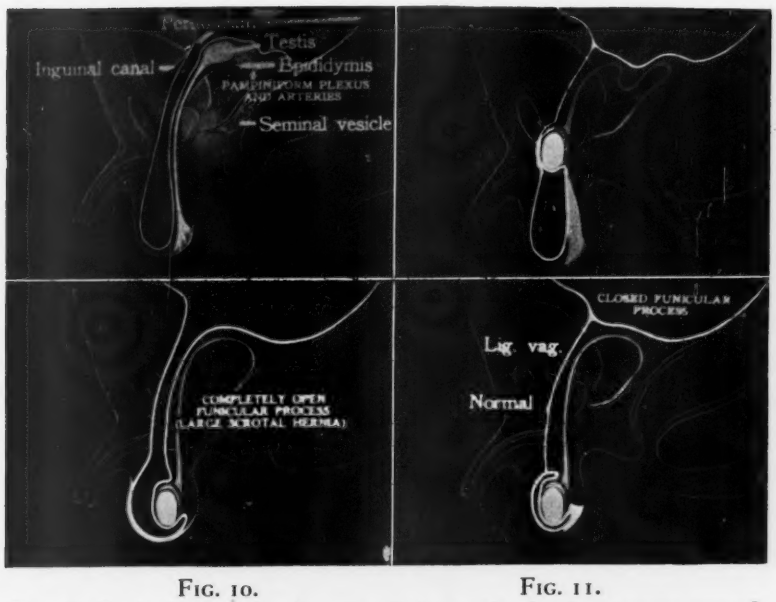


FIG. 10. FIG. 11.

FIG. 8. Beginning of the descent of the testis showing strong scrotal gubernaculum.
FIG. 9. Testis just below the subcutaneous abdominal ring.
FIG. 10. Failure of agglutination of processus vaginalis, forming a scrotal hernia.
FIG. 11. Testis and scrotum showing normally agglutinated processus vaginalis; ligamentum vaginalis.

DIFFERENTIAL DIAGNOSIS

There are certain conditions which may offer difficulty in the diagnosis of congenital inguinal hernia. They are:

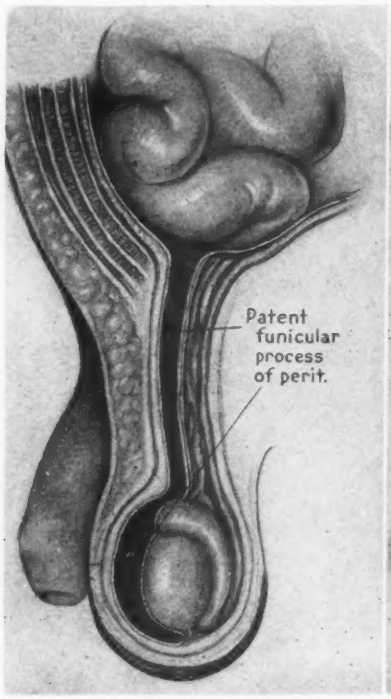


Fig. 12. Failure of closure of the tunica vaginalis, its lumen being continuous with that of the tunica vaginalis of the testis. Eventually this will become a large scrotal hernia.

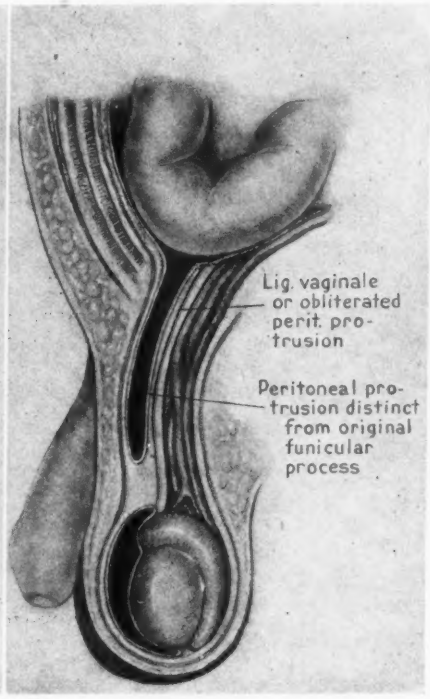


Fig. 13. The funicular process of peritoneum is completely closed by a peritoneal diverticulum which has occurred parallel to the ligamentum vaginale, simulating a congenital indirect inguinal hernia.

1. *Encysted Hydrocele of the Cord.* There is a localized swelling in the line of the spermatic cord, apparently part of it, and irreducible. A hydrocele of the spermatic cord is frequently mistaken for an irreducible hernia. The swelling is irreducible, yet there are no symptoms indicative of irreducibility. The spermatic cord is usually palpable above the upper limit of the swelling. The mass is movable, both in the long axis and across the spermatic cord. Hydrocele of the spermatic cord gives a distinctive palpable sensation. It is tense, smooth and fluctuates. There is no impulse on coughing.

2. *Lipoma of the Cord.* The swelling is always present. There is no impulse on coughing. The mass is media to the spermatic cord and it may be possible to differentiate the latter structure.

3. *Intermittent Hydrocele of the Tunica Vaginalis.* When an ordinary hydrocele is under examination, there is little likelihood of a mistake in diagnosis because the mass rests entirely below the palpating fingers when the spermatic cord is grasped. However, when an intermittent hydrocele is under consideration, in addition to the hydrocele of the tunica vaginalis, there will be found an incomplete closure of the processus vaginalis, the degree of patency being insufficient to permit a hernial protrusion, yet adequate enough to permit fluid to pass from the abdominal cavity into the tunica vaginalis. There is a history of intermittent swelling. On examination the spermatic cord will appear of increased size. Though a thickened cord is palpable, its width is never increased by the contiguous presence of abdominal contents.

The size of the swelling varies from time to time.

4. *Undescended Testis.* The hernial tumor is elastic and painless on pressure, while an undescended testicle is usually firm and tender.

THE DIFFERENTIAL DIAGNOSIS OF REDUCIBLE INGUINAL HERNIAS AND CONGENITAL HYDROCELES

| | Complete Reducible Inguinal Hernia | Congenital Hydrocele |
|---|---|---|
| Location | Swelling continuous with inguinal region | Same as in an inguinal hernia |
| Impulse | Distinct on coughing | No |
| Translucency | Not translucent, as a rule; rarely so in children | Translucent |
| When reduced | Gurgling of intestine heard under pressure; reappears rapidly | Reduction and reappearance slow |
| Relation to testes and spermatic cord. | Lies above or anterior to testis | As in hernia |
| Palpation and percussion. | Soft, semi-elastic; dull, if omentum; traumatic, if intestine | Harder and tenser; dull on percussion |

THE DIFFERENTIAL DIAGNOSIS OF REDUCIBLE SCROTAL SWELLINGS

| | Hernia | Congenital Hydrocele |
|---|---|---|
| Age | Occurs at all ages | Infancy |
| Appearance | Pyriform | Pyriform |
| Tactile sensation | Soft; semi-elastic | Hard; elastic |
| Impulse on coughing. | Definite; expansile | Usually absent; slight, if present |
| Translucency | Non-translucent in adult; may be translucent in infants | Translucent |
| Fluctuation | None | Present |
| Percussion | Resonant, if intestine; dull, if omentum | Dull |
| Auscultation | Gurgling, if intestine is present | Dumb |
| On reduction by taxis. | Feeling of solid, slipping body | Prolonged period for fluid to be cleared |
| Change on assuming supine position. | Will not reappear | Will reappear, but slowly |

EXTRAPERITONEAL OPERATION FOR REDUCIBLE OBLIQUE INGUINAL HERNIAS IN INFANTS AND CHILDREN

*Male.* Hernias in infancy may be treated by a spring truss or knitting yarn properly looped. In my opinion, a palpable or visible hernial protrusion is always surgical.

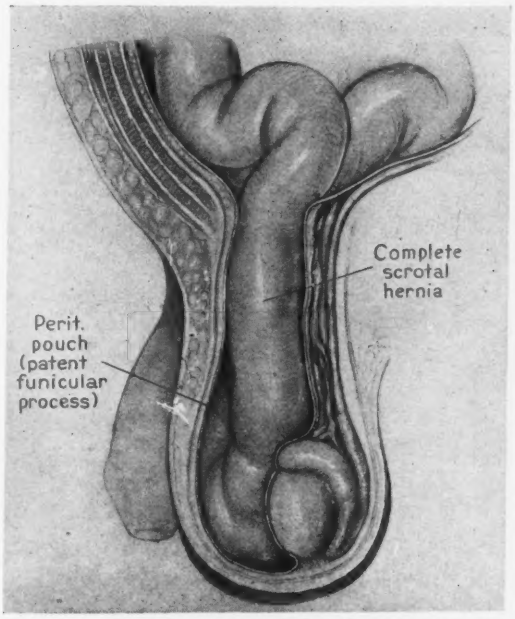


FIG. 14. Complete scrotal hernia wherein the funicular process of peritoneum (tunica vaginalis) is opened to its entire extent.

The operation is facilitated if the child is placed in the proper position upon the operating table. The thighs, even under anesthesia, remain slightly flexed upon the pelvis. The malposition is avoided by placing the patient with the buttocks on a sand pillow, and extending the thighs somewhat over the edge of the support. This changed position throws the inguinal rings forward.

*Operation.* The initial incision, one and one-half inches long, is made directly over the inguinal canal parallel to and one-half inch above the inguinal ligament. Its lower extent should be over the anulus inguinalis subcutaneous. The small subcutaneous

superficial epigastric vessels are caught, ligatured and divided.

The aponeurosis of the external oblique muscle comes into view and the anulus inguinalis subcutaneous is identified and brought into clear relief. The aponeurosis itself may be divided over the entire length of the inguinal canal. This facilitates complete removal of the hernial sac, the great desideratum in all hernial operations. This procedure is not always necessary.

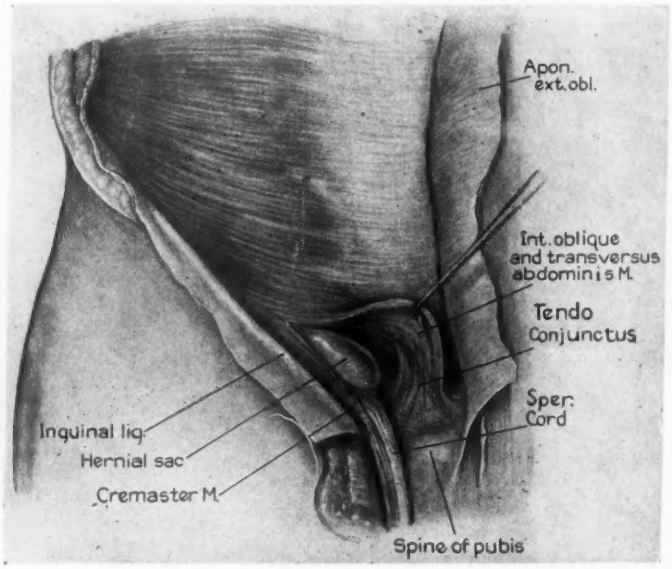


FIG. 15. Sac of indirect inguinal hernia and its relation to the neighboring structures.

The fascial envelopes of the spermatic cord, raised from their bed, are divided; first, the external spermatic and then the cremasteric. The sac, invaribly thin, now looms through the internal spermatic fascia. It will be found closely adherent, especially in long-standing cases, to the upper and medial part of the spermatic cord structures. The fascia (together with the vas and veins, which are usually more adherent than the other structures) is now separated by blunt dissection from the sac down to its neck. Great care and extreme patience are often required in this dissection in order to avoid tearing the sac at and in the anulus inguinalis profundus. Such an accident may lead to partial evisceration and shock.

Many surgeons divide the hernial sac; the upper part is separated from the spermatic cord and treated, as is its counterpart in the scrotal varieties of hernia; with the lower part there is a choice of methods. Some surgeons permit this divided end to drop back unsutured. It is better not to divide the sac, but remove it *in toto*.

If the spermatic cord is put in traction and teased out laterally, the hernial sac can, as a rule, be identified by its translucency and its glistening, grayish-yellow color. Care should be exercised not to injure the ductus deferens, which usually is adherent to the posterior surface of the sac. There is considerable variation in the character of this structure. In the vaginal type, it is always thin and closely adherent to the tissues of the spermatic cord.

The sac may be opened to further identify it as such and to ascertain whether any intra-abdominal viscus, a part thereof, or any associated structure, adherent or free, is confined therein. The usual hernial content is small intestine. The omentum is found less often than in the adult. It is usually unnecessary to open the sac. Palpation and visualization are sufficient safeguards against traumatizing an incarcerated viscus.

It is easier to reduce the contents before the sac is opened. It is often advisable, after inspecting the interior of the sac for adhesions, to insert the index finger and then to brush aside contiguous areolar tissue and the spermatic cord while causing traction on the sac with the finger within. Thus, a high transfixion of the sac may be accomplished. Firm, but non-violent, traction is made upon the sac; the neck, often identifiable by an accompanying pad of yellow, extraperitoneal fat, is transfixed as high as possible and the redundant part of the twisted sac is tied two ways and cut off just above the level of the parietal peritoneum, leaving an adequate stump to retract into the abdominal cavity.

Two or three sutures of No. 1 chromic cargut may sometimes be employed to stitch the internal oblique muscle and the tendo conjunctus to the inguinal ligament superficial to the spermatic cord. This step, however, is not essential. The divided margins of the external oblique aponeurosis are approximated with a few fine chromic catgut sutures. The skin is sutured with black silk. The wound is then covered with gauze saturated with collodion for waterproofing.

## ACCIDENTS IN INGUINAL HERNIA OPERATIONS

Certain of the following contretemps are occasionally met with in inguinal hernia operations: (1) Injury to the spermatic cord, with the sequelae of thrombosis of the veins and subsequent infarction of the testis; (2) injury to the spermatic artery, with, at times, necrosis or atrophy of the testis; (3) division of the vas deferens; (4) injury to the urinary bladder; (5) injury to the inferior or deep epigastric blood vessels; (6) injury to the external iliac vessels; (7) injury to the intestine, and (8) injury to the omentum.

## PROGNOSIS

The proportion of cures which should be obtained is approximately as follows:

Recent inguinal hernias in childhood—oblique inguinal—and in young adults—100 per cent.

## INGUINAL HERNIA IN FEMALE INFANTS AND OLDER CHILDREN

An inguinal hernia in a female infant is a relatively rare occurrence. The proportional incidence of hernia in male and female children is about 20:1.

*Pathology.* The sac, usually small and pear-shaped, lies on the ventral surface of the round ligament.

The sac-content is frequently an ovary. The hernial sac may also contain oviduct and omentum or intestines. If the hernia is a large or massive one, the body of the uterus, among other structures, may become one of the contents. The author has found this condition in two cases.

*Diagnosis.* In female infants and older children there are three conditions which may simulate inguinal hernia: (1) hydrocele of the canal of Nuck; (2) enlarged inguinal glands, and (3) femoral hernia.

Table 1

| | |
|---|---|
| *Total Number of Cases* | 150 |
| Sex | |
| Males | 138 |
| Females | 12 |
| Total | 150 |
| Age | |
| Under 6 months | 76 |
| Over 6 months | 74 |
| Side | |
| Right | 71 |
| Left | 56 |
| Bilateral | 23 |
| Results | |
| Cured | 150 |

One recurred (?). There was a suggestion of a recurrence in a male infant twelve months old. Further operation is contemplated to determine whether the condition is really a recurrence.

A hydrocele of the canal of Nuck resembles irreducible hernia in which the ovary may be one of the contents of the hernial sac. It may be impossible to differentiate between the two conditions. The hydrocele, however, is often completely irreducible. It is not tender and fluctuates on palpation.

Enlarged inguinal glands may be excluded because of their position and the absence of an associated lesion.

Femoral hernia is differentiated because of its relationship to the spine of the pubis; the neck of the femoral sac lies external to, and at a lower level than, that anatomic landmark.

In principle and technically, the operation for reducible, oblique inguinal hernia in women is the same as that for men, the round ligament being treated in a manner similar to the spermatic cord, or the ligament is sutured to the structures of the inguinal canal. When it is impossible to separate the ligament from the sac, part of it is removed with the sac and the cut ends are approximated and sutured.

The developmental defect causing this variety of hernia in women simulates the normal descent of the testis in the male. The gubernaculum of the ovary (the anlage of the ovarian and round ligaments) become attached to the cornu of the uterus. This prevents the descent of the ovary into the inguinal canal under normal conditions, despite the fact that the distal end of the gubernaculum is attached to the labium majus, the homologue of the scrotum. A hernia occurs when this mechanism becomes defective. The canal of Nuck (which is analogous to the processus vaginalis in the male) normally becomes obliterated at the end of the eighth intrauterine month, but may remain patent throughout adult life.

## SUMMARY

1. Inguinal hernias in infants should be operated upon as soon as the condition is diagnosed.

2. Knowledge of anatomy and embryology is important.

3. Anesthesia may be local or general.

4. The infant may be sent home within a few hours.

5. There should be no recurrences.

# A PEDIATRIC UROLOGICAL PROBLEM IMPORTANT TO THE GENERAL PRACTITIONER*

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IT is my belief that the condition of congenital urethral valves occurring in the infant male has received far too little recognition. Nine out of every ten physicians seem to be entirely unfamiliar with this pathological entity. On the other hand, one cognizant of this condition can readily reach a presumptive diagnosis on the basis of a history and physical examination alone. All too frequently these cases are classified as an enuresis problem and should the usual remedies fail are cast aside as fundamentally a functional or behavior problem.

Primary symptoms depend on the degree of urethral obstruction offered by the valves; the range may vary from slight straining during the act of micturition up to the point of complete retention. As intermediate symptoms one should mention dysuria, a small stream, frequency, nocturia, dribbling and overflow incontinence. The course of events is quite similar to that seen in the prostatic case. Whereas enuresis is a bed-wetting problem occuring only during sleeping hours, the urethral valve presents diurnal urinary difficulties as well. Intermittent costovertebral angle pain appears as a later symptom due to back pressure on the upper tracts. Concomitantly, with the initiation of renal damage and insufficiency leading to uremia, one witnesses the systemic symptoms of the latter condition, namely, anorexia, nausea, vomiting, headaches, weight loss, stunted growth and secondary anemia.

*History.* About 130 cases of this condition have been reported in the literature to date. The fact that over half of these were not discovered till autopsy emphasizes the high incidence in which this entity passes unrecognized clinically. Langenbeck first described the pathological findings in 1802. Thirty years later Guthrie and Velpeau working independently reported the effects of the urethral obstruction on the upper urinary tracts. Clinically the condition was first recognized by Eigenbrodt in 1891. Thirty-one years ago Knox and Sprunt were the first in this country to describe their findings. Back in 1912, a prominent ridge coursing along the urethral floor between the external sphincter and the verumontanum was witnessed with a cystourethroscope. The following year Young successfully operated on a patient via the suprapubic route. On opening the bladder the vesical neck was found to be dilated and distally two semilunar valves were seen and destroyed by electrocautery.

*Types of Valves.* According to Young's classification urethral valves may be fit into one of three catagories: (1) Those arising from the distal portion of the verumontanum; ballooning anteriorly and finally inserting on the lateral urethral walls; (2) those passing like folds of mucous membrane from the posterior part of the verumontanum to the region of the vesical neck; (3) an iris type valve which may occur in any portion of the prostatic urethra.

*Etiology.* Although there are several etiological explanations none will account for all the congenital possibilities. Watson believes the valves are formed *in utero* by a fusion of the colliculus seminalis with the roof of the urethra due to erosion of contiguous surfaces while under continual external pressure. He has several sections

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including a fourteen weeks' fetus showing this fusion. Another explanation is a developmental anomaly with undue promi-

Fig. 1. A cystogram in the Trendelenburg position showing a cavitated prostatic urethra, a contracted bladder with small diverticula, an incompetent left uretero-vesical valve, a dilated, tortuous left ureter and a fourth degree hydronephrosis.

Fig. 2. A cystogram utilizing the Trendelenburg position showing the amount of reduction in the size of the left upper tract after four weeks' catheter drainage.

nence of the Wolffian and Mullerian ducts at the point where they enter the verumontanum. Other investigators have suggested hypertrophied folds as an etiological basis. Lederer believes the membrane is a remnant arising from the fusion of the entoderm with the ectoderm. The last hypothesis seems most appropriate to explain the iris type valve while Type I and II in Young's classification might be accounted for by any of the other theories.

*Pathology.* Because of the nature of the valves (Type I and II) which are not unlike those of the aorta in principle, a urethral catheter can generally be passed with little or no resistance. Of course, this situation is not found in the case of the iris type valve. In the latter condition one is fortunate if the lumen can be located with a filiform. The degree of the pathological condition in the bladder and upper tracts is proportional to the amount of obstruction. Some cases have advanced to such an extent *in utero* that death ensues a day or two postnatum. The disorder is quite similar to that seen in urethral obstructions due to such causes as prostatic hypertrophy, urethral stricture and so on.

As the bladder fails entirely to overcome the resistance of the valves, it accumulates a residual urine. Along with continued efforts to evacuate itself, the muscle fibers hypertrophy in groups or bundles giving rise to trabeculation. Concomitantly with the increased bladder pressure that portion of the urethra proximal to the valves becomes dilated. In advanced cases the prostatic urethra is markedly cavitated and appears not unlike the prostatic bed

following an enucleation. Unfortunately, the effects of the back pressure are not limited to the lower tract but are transmitted above and will eventually produce a hydroureter and hydronephrosis. As the ureter dilates its very weight causes it to sag and angulate to the point where it presents a picture of alternate points of constriction and sacculation. Less frequently the uretero-vesical valve will become incompetent. Under these circumstances the entire pressure is transferred to the upper tracts permitting the bladder to remain permanently contracted. The ultimate course will be that of renal insufficiency and a uremic death unless some intercurrent infection should intervene to hasten death.

In addition to the primary bladder symptoms and the secondary effects of renal back pressure the condition of urinary stasis predisposes to secondary infection. With its advent all symptoms are accentuated and accompanied by fever, chills, toxicity and occasionally calculi formation.

*Diagnosis.* Differential diagnosis must exclude hypertrophy of the verumontanum contracture of the vesical neck, neurogenic bladder, chronic nephritis and polycystic kidney. Besides a good history and physical examination there are other diagnostic methods available such as residual urine determination, panendoscopy, intravenous pyelogram, cystogram, urethrogram and retrograde pyelography. Should the residual urine be large and evidences of chronic backpressure be present it is decidedly inadvisable to decompress completely for the sake of a total residual determination. Occasionally a cystogram, if taken with the patient in the Trendelenburg position, will outline one or both upper tracts. Should the patient be in uremia or in a state of impending uremia, an intravenous pyelogram is of no avail as the renal function is inadequate to concentrate the dye sufficiently for visualization. Passing a panendoscope under direct vision is the most ideal method of visualizing the primary pathological condition.

*Treatment.* If a catheter passes, the initial treatment should be limited to a gradual release of the upper tract pressure. This step alone may require several weeks. When the patient has reached a stage wherein free drainage may be maintained, it should be continued until the blood urea or non-protein nitrogen maintains a fairly stationary level. Many of the earlier attempts to treat urethral valves failed due to lack of appreciation of this one point.

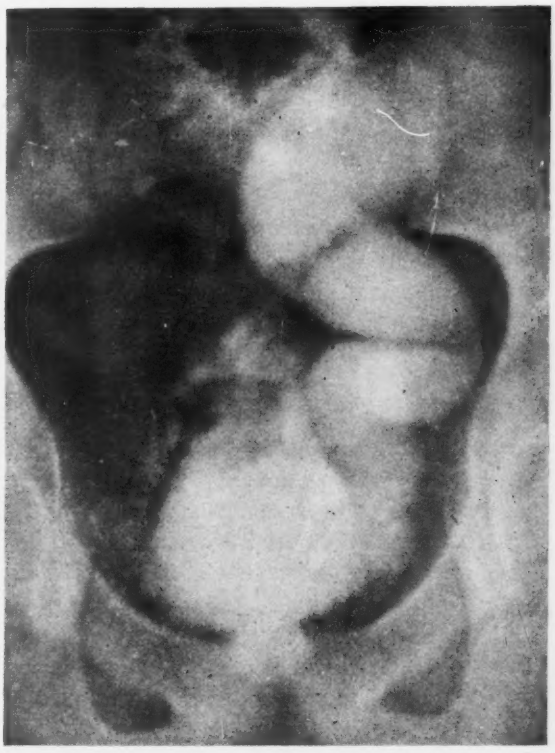

FIG. 3. A cystogram showing considerable increase in the bladder size as well as the left ureteral stump terminating over the sacroiliac joint. The latter acts as an accessory bladder.

Valves may be destroyed via the suprapubic route using the scalpel, cold punch or electrocautery as in Young's first case. Later Young achieved good results with the punch resection per urethra. In 1921, Randall satisfactorily treated two patients with a fulgurating electrode through a cysto-urethroscope. Campbell has had equally good results in forty-seven cases of congenital bladder neck obstruction

using his baby resectoscope. Urethral dilatation may be used as a method of therapy but in general because of the nature of the valves, it is not entirely satisfactory.

## CASE REPORT

No. 48312. O. S. a fifteen-year old boy, was admitted to the Urological Service December 3, 1943. Since infancy he had been afflicted with diurnal dribbling and nocturnal incontinence. Occasionally, his symptoms were accentuated by bilateral loin pain and accompanied by fever and chills. A voluntary effort to void merely produced a more rapid rate of dribble followed by a short period of continence. Five years previously he had had a urogram and was told that nothing could be done for his condition of "infantile bladder." In general his appetite was poor; he tired readily; suffered numerous headaches; was markedly undersize and underweight for his age and showed poor resistance toward upper respiratory infections. He had had no other serious illnesses or operations in the past.

His temperature was 99.2°F., pulse 96 and respirations 20. Physical examination revealed a sallow complexioned boy who was underdeveloped, poorly nourished and obviously chronically ill. The head was normal. The heart was slightly enlarged to the left; the sounds were of good quality with regular sinus rhythm and no murmurs. Blood pressure was 170/130. The lung fields were clear. Both kidneys were enlarged and tender; a tender mass also was felt suprapubically to the left of the mid-line. The genitalia were those of a normal male; the prostate was small, smooth, nontender and fluctant. Reflexes were physiological.

The admission urine was amber clear, alkaline, specific gravity 1.006, sugar free, trace of albumen and microscopically negative. The hemoglobin was 70 per cent; erythrocytes 3,700,000; leucocytes 8,000; 80 per cent polymorphonucleocytes and 20 per cent lymphocytes. Blood urea nitrogen was 58.3 mg. per cent; blood calcium 11.8 mg. per cent; Kahn test negative.

The initial treatment consisted of the passage of a No. 18 French catheter and a regime of withdrawing 100 cc. of urine every two hours. Free drainage was not possible for several days due to severe suprapubic pain whenever a certain minimum pressure level was reached.

A flat plate of the abdomen showed tremendous enlargement of the renal shadows but no calculi or obliteration of the psoas borders. Diodrast given intravenously was seen on the right side after forty minutes; none was seen on the left up to two hours. The calyces of the right kidney were enlarged and blunted; the pelvis was dilated to a second degree hydronephrosis. The bladder was not visualized. After the third day of drainage a cystogram was taken with the patient in the Trendelenburg position using 300 cc. of a 3 per cent sodium iodide solution. (Fig. 1.) This procedure due to an incompetent left ureterovesical valve or sphincter showed a fourth degree hydronephrosis, a markedly dilated and tortuous ureter, a contracted bladder with small diverticula and a cavitated proximal urethra. No reflux occurred up the right side.

After twelve days' drainage the blood pressure dropped to 154/102 and the blood urea to 37.5 mg per cent. At this time under general anesthesia the urethra was dilated to a No. 26 French sound but not without meeting some resistance in the bulbous and prostatic urethral regions. The sound was followed by a No. 24 French Brown-Buerger scope which revealed prominent trabeculation of the bladder wall. The right ureteral orifice was natural; the left dilated to approximately 1.5 cm. The prostatic urethra was cavitated down to the mid-portion of the verumontanum suggesting a Type 1 urethral valve after Young's classification. Ultimately the urea nitrogen reached a relatively stationary level at 40 mg. per cent and the blood pressure was recorded as low as 126/80. At this time, although the patient had a fair size stream, he could only void about an ounce at a time as the bladder collecting capacity was largely assumed by the dilated left upper tract. Since the left kidney was a non-functioning sac a nephrectomy was advised with the hope that the elimination of this accessory bladder so to speak would increase the intravesical tension and possibly aid in re-establishing normal bladder function.

After four weeks' catheter drainage (Fig. 2) a eft nephrectomy was performed under drop ether using the classical twelfth subcostal, muscle-sectioning, retroperitoneal approach. The nephrotic sac and the dilated ureter was removed down to the approximate level of the pelvic brim. The wound was closed in layers about a Penrose drain. The postoperative course was uneventful.

Two weeks postoperatively a cystogram in the Trendelenburg position showed little change in the bladder size and a small amount of reflux up the left ureteral stump. The ureteral catheter was removed and the urethra dilated to No. 26 French sound. At the time of discharge four days later the patient was voiding a good size stream at hourly intervals. The urine was hazy, specific gravity 1.008, albumen a trace and a moderate number of pus cells present per high power field. The blood urea nitrogen was recorded at 32 mg. per cent.

One month after discharge the boy was readmitted for a check-up. At this visit he was voiding approximately 200 cc. of slightly hazy urine every two hours. The urine never concentrated above 1.008 and always revealed a trace of albumen. The blood pressure was 146/106 and the urea nitrogen 30 mg. per cent. The bladder showed very little effort to re-expand and the ureteral stump was still acting as an accessory bladder. The urethra was dilated to a No. 27 French sound.

On his most recent check-up (six months postoperatively) this boy was asymptomatic. His cheeks had regained a healthy color; he had gained fourteen pounds in weight; the interval between voiding had increased to three hours, the quantity to 300 cc. A cystogram showed considerable increase in the bladder size with the left ureteral stump still acting as an accessory bladder. (Fig. 3.) The blood pressure remained around 158/108 and the urine showed a few pus cells per high power field.

## SUMMARY

Any male child with a persistent urinary problem which fails to respond to the usually enuresis regimes in a reasonable period of time should not be cast aside as a behavior problem but should be given the benefit of a urological investigation. The fact that over half of the 130 cases of urethral valve reported in the literature were not diagnosed ante-mortem emphasizes the fact that this pathological entity is not as widely known as it should be. In general the symptoms are diurnal as well as nocturnal and not unlike the course of events seen in the elderly male with obstructive prostatic hypertrophy. The rapidity of renal destruction depends directly upon the degree of urethral obstruction. The etiology is not clear-cut; the anatomical structure generally conforms to one of the three types described by Young. The history and physical findings will often make the diagnosis whereas cystopyelography and panendoscopy will definitely confirm it. Rapid decompression is to be discouraged. The valves may be destroyed either transvesically or endoscopically using either a cutting current or a cold punch. The prognosis depends on the amount of renal damage done prior to diagnosis, the preoperative care and the operative and postoperative management.

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When strictures of the urethra cannot be treated by dilatation, or when quick results are desirable, internal urethrotomy is indicated. This operation is not to be attempted when an instrument cannot be passed through the stricture.

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# PRIMMARY OMENTAL TORSION*

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CLOSETED within the parietal peritoneum lie the abdominal and pelvic organs, solid and hollow viscera, each heir and liable to the various pathologic processes of biology: inflammation, degeneration, embryonic dysplasia, and neoplasm. According to the extent of visceral peritoneal covering, these various viscera are fixed (sessile), or else pedunculated or moveable by reason of a mesentery. This latter group of organs, because of their inherent moveability are susceptible to a physical hazard to which its sessile neighbors are not exposed, namely, torsion.

Torsion is defined as twisting. Torsion as it is applied to abdominal organs or tumors implies the rotation of whole or part of the affected structure upon itself, with the formation of a narrowed neck or pedicle, where the circulation to the distal mass becomes constricted. In order to warrant clinical notice, such twisting must cause some degree of circulatory obstruction, since it is axiomatic that any process which produces neither subjective symptoms nor objective (circulatory) changes is purely physiologic and does not justify the category of a pathologic entity. This qualification becomes necessary lest our discussion and classification become confused and encumbered with polynyms and epinyms ("partial," "incomplete," "temporary," etc.).[69]

Perhaps the most familiar examples of torsion are those associated with cystic and solid tumors of the ovary and pedunculated subserous fibroids, where the presence of a long thin pedicle provides an ideal physical condition for the inception of an axial twist. Torsion of the spleen,[95] the testicle, and the appendices epiploica[22,93] are not uncommon. Torsion of the gallbladder,[49] cecum,[83] fallopian tube,[100] and lesser omentum[39] are rare. Besides a variety of tumors, any abdominal organ except the liver may undergo rotation.[9]

Torsion in the alimentary tract presents its own peculiar pathologic problem, since twisting sufficient to cause some circulatory embarrassment must simultaneously restrict or occlude the normal flow of intestinal contents. Clinically, this is intestinal obstruction, and when it is produced by this mechanism it is known as "volvulus." The application of the term "omentovolvulus" to omental torsion by various authors,[53,92] however euphoneous, is a misnomer.

It is our purpose in this communication to focus attention on torsion as it occurs in the great or gastrocolic omentum. Until recently, medical teaching and surgical textbooks ignored the subject entirely or mentioned it lightly in passing. With the turn of the century there came a rapid accumulation of reports and reviews on this entity, and its subsequent insertion in references and standard teaching texts. In the light of increasing numbers of case reports from all corners of the earth, torsion of the omentum cannot be regarded as a rare clinical occurrence. Omental torsion is one of the uncommon causes of acute abdominal crises of obscure etiology,

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demanding differentiation from other familiar and uncommon intra-abdominal lesions.

It is our contention that it is a clinical condition which still suffers unwarranted neglect in surgical teaching and consideration of the differential diagnosis of the acute abdomen. Omental torsion is hardly ever thought of or mentioned as a cause for vague abdominal pain. Lest this indictment of general surgical acumen be lightly dismissed, we make this plea for a review of the entire subject, so that opinion as to its relative surgical importance may be judiciously rendered.

Since all the early cases of omental torsion reported[2,73,23] were associated with a right inguinal hernia, this concurrence was considered an essential combination until 1899, when Eitel[30] reported the first case of intra-abdominal torsion occurring independent of the presence of an inguinal hernia. Scudder,[87] in 1904, claimed that his was the first case of primary torsion to be reported, but Baldwin[5] and Syme[97] had each reported a case in 1902.

Following Eitel's report, it became evident that omental torsion need not be accompanied by a hernia, and a division into hernial and abdominal types evolved. Upon its basis, there has mushroomed a top-heavy, unwieldy classification. A number of varieties of omental torsion must be recognized, but far too many sub-divisions have been advanced and advocated, and the stage has been reached where the same term possesses a different meaning in another's classification.

In rare and uncommon affections, particularly when they are not well understood, there is a tendency to elaborate a complex classification in an attempt to provide a category covering any observed or postulated variety, thereby defeating the prime purpose of classification. The sole object of medical classification is to express by arrangement and nomenclature the essence of variety in fundamental phenomena, in order to facilitate recognition, understanding, teaching, and transmission of ideas. The surgeon must accept only a subdivision so simple and inclusive that it is part of his regular mental equipment, ready for instant service during physical examination, discussion, and operation. In this way, all the participants may comprehend distinctions without recourse to texts and references.

Despite the differences in terminology and grouping of sub-types, every previous classification recognized the premise that all cases of omental torsion may be divided into two main etiologic types: (1) Those without apparent cause (idiopathic, cryptogenic, or primary abdominal); and (2) Those associated with or complicated by any pathological condition (secondary) either within the abdominal cavity, or without (hernial, external). Once this fundamental differentiation is recognized, several categories suggest themselves, and any form of pertinent variation may be catalogued. We propose the following simple classification as sufficiently broad to embrace all the reported types:

A. Primary (idiopathic, cryptogenic, pure intra-abdominal)
B. Secondary
   1. Hernial (external)
   2. Abdominal
      a) Intrinsic (i.e. cysts & tumors of the omentum)
      b) Extrinsic (pathology of the abdominal & pelvic organs, and peritoneum).

Several authors (Smythe,[90] Hedley[41] and Mesa[64] reported cases of pure intra-abdominal omental torsion, in which a right inguinal hernia was present, but claimed that this latter co-incidence was without etiologic significance. Clinical experience has taught us that a hernial mass will frequently reduce itself spontaneously, the sac being found empty on operation. The co-existence of a right inguinal hernia with a case of primary omental torsion is too significant to be coincidental, and its hernial onset must be assumed. There is no need to add a "combined" form to the classification (Morris[69]).

When Corner and Pinces[17] tabulated all the cases reported up to 1905, forty-eight of the fifty-four were of the hernial type, almost 90 per cent. In 1928, Morris[69] published a comprehensive review of the entire subject, listing 161 cases from literature (three cases have been deducted from his total, since they are "incomplete" and do not meet the criteria of pathologic torsion), eighty, or 50 per cent were hernial. Lipsett[58] (1941) added eighteen additional cases from the literature up to 1937, only 12 per cent of which were hernial. This rapid decline in the relative frequency of hernial type reported might be variously interpreted, and we offer the following hypothesis: First, with improved surgical diagnostics and operative technic, a certain percentage of cases of hernia (however small) which might have developed omental torsion undergo surgical repair before the omentum reaches the sac, while in those cases in which the omentum does descend into the sac it is released by surgery rather than by "taxis," which maneuver might very well have imparted the precipitating force for the onset of an axial twist. Secondly, numerous cases of the hernial type encountered may have been considered too common to warrant a case report.

Once the subject of omental torsion has been explored, interest tends to concentrate upon the primary type, in view of its relative infrequency, curiosity as to its cryptogenic origin, and speculation as to its preoperative diagnosability. McWhorter[63] had compiled twenty-eight cases of this type from the literature up to 1928. In 1930, D'Errico[24] devoted his entire article to this type alone, giving an abstract of each of the thirty-nine cases reported. Andrews[4] brought the total of the primary type to fifty-four in 1938. In view of the existing world-wide hostilities, medical literature is in a chaotic state, and no estimation of the number is, or should be attempted, in deference to accuracy.

The clinical importance of primary omental torsion depends directly upon the great omentum. Since the other characters in the abdominal theatre attract more attention, the omentum is often viewed out of focus, and this lack of perspective leads to the uncritical impression "the great or gastrocolic omentum has never played a prominent part in clinical surgery, its rôle generally being accepted rather as an inert structure with a function more or less vague and a relationship to clinical symptoms too remote to merit serious consideration" (introduction, Morris[69]). This relegation to an unspectacular part does not restrict its repetoire, since the omentum is supposed to take some part, however small, in a supporting rôle of most of the abdominal tragedies.

In order that we might better appreciate its actual importance, we present herewith the great omentum, the lead in the production (mechanism) of primary omental torsion, prefacing an introduction (embryology and phylogeny) to its character (histology and anatomy) in health (physiology) and disease (surgical pathology). Celcus is credited[46] with first using the term "omentum," but its derivation is obscure, being variously attributed to "operit" (to cover, i.e., the intestines), "opimus" (fat), and "omen," since the haruspices made prognostications from it.

## THE OMENTUM

*Embryology.*[44,59] The embryology of the omentum is directly dependent upon the development of the stomach. The anlage of the stomach can be recognized in human embryos of 4 mm. to 5 mm. as a laterally flattened fusiform enlargement of the foregut, suspended from the roof of the celomic cavity by part of the common dorsal mesentery known as the mesogastrium. Dilatation of the embryonic stomach goes on more rapidly on the dorsal than on the ventral side, thus producing the greater and lesser curvature, respectively. Beginning in embryos of 12 to 14 mm. the stomach undergoes a rotation on an axis in two planes, producing an

approximate transverse position, with the cardiac (cephalic) end on the left, the pyloric (caudal) end on the right, the lesser curvature facing upward, and the greater curvature directed downward. During this complicated maneuver, the greater curvature carries along the dorsal mesogastrium, converting it into a double fold, like a pouch, containing two layers of flattened endothelium. As the omentum descends, the transverse colon is ascending to its adult position, so that after the fourth month of fetal life the posterior layer of the omentum lies over and adheres to the transverse mesocolon. No actual fusion of elements takes place, and this physiologic adhesion may be separated, since the omental circulation is derived from the epiploic vessels of the greater curvature, and never anastomosis with the mesenteric circulation of the transverse colon. The boundaries of the omental bursa are now complete, and it has assumed its permanent position. At birth, the omental pouch may still be inflated through the foramen of Winslow, but an agglutination of these layers begins soon after birth, obliterating the omental pouch.

*Comparative Anatomy.* Philogenetically, the first indication of an omentum is seen in the lowest forms of vertebrates (the giant salamander). Heusner[47] regards this as a higher stage of evolution, since the omentum is absent in fish. To a certain extent, omental development seems to be determined by an animal's habits and stage of evolution. Thus, birds have only a very primitive omentum. In certain herbivorous animals, in which the excessively enormous size of the stomach (60 to 80 pounds) would readily lead to volvulus of that organ, the omentum serves to stabilize it by sheer weight and by its fixation to the ventral abdominal wall below. In the hibernating mammals, a deposition of excess fat in the omentum during the season of plenty and satiety, serves not only as a storehouse but also an insulating blanket in the lean, cold days of hibernation. In the quadruped, the omentum is a labile cushion interposed between the mobile visceral peritoneum and the immobile parietal peritoneum, lying in the dependent portion of the abdominal cavity, and indirectly bearing much of the weight of the viscera. In the course of philogenetic evolution, the assumption of an upright posture led to anatomical alteration of the abdominal organs (including the omentum) in readjustment to the pull of gravity. The adhesion to the transverse mesocolon described under embryology, occurs only in man and certain of the erect primates.

*Histology and Anatomy.*[86] The great omentum consists of a double sheet of flattened endothelium, between which run the epiploic vessels, lymphatics, and nerves, enmeshed in areolar tissue with a variable amount of fat distributed in its meshes. It is a highly vascular organ. It becomes a composite four-layered structure by hanging in a double fold, sling-like, from the greater curvature and the transverse colon, like a curtain attempting to shield the intestines from sight. The curtain-like structure lends itself to the formation of folds and tongues, which may normally extend between the intestinal coils. The attachment of the right border to the pylorus varies, and it may sometimes extend over to the duodenum, and even to the gallbladder. Aberrant attachments in this area are the frequent cause of alimentary derangement.[28] The left border forms the ligament to the spleen, and fixes it to the stomach.

The shape, the size, the weight, and the position of the omentum show marked variability, even in the absence of any intra-abdominal disorder. One side, usually the right, may be found longer than the other. It may possess two or more tongue-like processes, have accessory omenta attached to the main organ, or may have processes similar to appendices epiploicae hanging from its free margin. It may be found concentrated in any quadrant of the abdomen. Its length varies from a mere vestige to an enormously elongated mass

reaching into the pelvis. In fat individuals it may attain huge proportion and weight. In emaciated persons as a rule, the omentum is found to be very thin, devoid of fat, and sometimes shriveled to a mere shred.

Concomitant with senile changes and also in those persons in whom the loss of a large amount of adipose tissue has occurred, the transverse colon has a "V" or "U" shape, and in those individuals in whom the stomach is ptosed or distended, practically the entire omentum may occupy the pelvis. When the colon is markedly dilated, as in obstruction or meteorism, the omentum is found high up in the abdomen, often rolled around the posterior aspect of the colon. In the presence of ascites the omentum is invariably found coiled up, and lying along the upper or lower border of the transverse colon, or against the stomach. In cases in which the abdomen contains very large quantities of fluid, the omentum may be found lying on the anterior surface of the liver, and in rare instances it is found floating upon the fluid.

*Physiology.* The omentum is not a vital physiologic organ. It may be congenitally absent[45] and it may be totally removed without appreciable discomfort or disturbance to the individual.[28,46] However, posterity has endowed the great omentum with an extravagant reputation for virtues and capacities. Sown promiscuously, many of these fertile misconceptions flourished to be reaped periodically by certain reviewers (Browman,[12] Heusner,[47] Rubin[86]) and to which we add a crop of our own gleaning.

The ancient anatomists regarded it from a utilitarian aspect. Aristotle thought it blanketed the abdominal organs against cooling. Galen, who filled the omental bursa with water to examine it better, agreed with this view. Vesalius described the omentum as a ligament for the fixation of the transverse colon. Verboyen gave it the capacity to protect the intestines from friction. Hansen believed that it facilitated respiration by drawing the filled stomach downward.

Experimental physiology revealed that the "moistening" power of the peritoneum was really the property of producing an exudate, while the introduction of foreign particles into the peritoneal cavity demonstrated a marked capacity of the omentum for absorption. Heger[42] likened the omentum to a washrag which cleaned out the abdominal cavity.

Hektoen and Reisman[43] regarded it as a sort of nervous heart in the abdominal cavity, which keeps up an imperfect form of circulation, serving to transude plasma or lymph into the cavity and absorb what is already there. Tait[98] called it the "arbiter of peritoneal tides," Draper and Johnson[28] who described the omentum in the quadraped, as "the bilge-pump of the peritoneal cavity," question this power in the human, pointing out that in the quadruped, the omentum occupies the most dependent part, to which all foreign matter, exudates, etc., will gravitate. This selectivity of the omentum for absorption is decreased with the assumption of an erect posture. The pelvic peritoneum, which has now become the gravitational cesspool, has undergone histologic modification of increased vascularity and lymphatic drainage, hence the use of Fowler's position for intra-abdominal inflammation.

The vascularity and rich lymphatics of the omentum suggested protective properties as an expanded hemolymph organ within the abdomen. Albrecht[3] likened its ability to that of a giant leucocyte whose potentiality is evident with the onset of an inflammatory process. Pirone[77] demonstrated the phagocytic efficiency of its transformed endothelial cells. Goldschmidt and Schloss[37] elaborated on a bactericidal function, which Roger[84] had demonstrated by experiment.

The variability of the position, conformation, and visceral relations of the omentum as discovered at laparotomy and necropsy led observers to attribute to

it some inherent migratory power. Cornil and Carnot[18] described this spontaneous motion as "intelligent." Milian[65] ascribed the activity to "positive and negative chemotaxis," or "intelligent chemotaxis." The belief that the omentum possesses this inherent motility, or that it might move in response to a stimulus, is an impression shared by a majority of clinicians and surgeons. This presumption is the result of credence given to dogma, since "almost all students are informed that the omentum is 'the great protector of the abdomen' which, by some strange inherent power seeks out and tries to arrest trouble."[85] The foremost protagonist of intrinsic mobility, Rutherford Morison,[68] was the first to use that universal metaphor "the abdominal policeman" in teaching his classes. He likened omental movements to that of a jelly-fish. He believed that there could be no doubt that "it travels about in the abdomen with considerable rapidity, and is attracted by some sort of information to neighborhoods in which mischief is brewing." That the omentum is indeed capricious in its response to such calls of duty has been frequently observed at laparotomy and necropsy, and the absence of any intrinsic migratory power has been repeatedly demonstrated by experiment. Fagge[32] has remarked that "the factors which induce the purposeful migration of this 'abdominal policeman' to different parts of the peritoneal cavity constitute a problem which cannot escape the curiosity of every surgeon, yet, so far as I can discover, no one has supplied a logical answer to it."

It will be recalled that, except for a small amount of smooth muscle in the arterial walls, the omentum is entirely devoid of muscle. Nevertheless, it will be difficult to dispel the mirage of omental mobility from current common credulousness. Those authorities who have performed controlled experiments agree with Wilkie[103] and conclude that "there is absolutely no motion." Draper and Johnston[28] concluded that "it is devoid of all automotive power" and "its migration is as much accidental as selective." Rothenberg and Rosenblatt[85] who recently reported their observations on omental mobility under fluoroscopy (an experiment previously performed by Heger) came to the conclusion that the "omentum is moved passively by exaggerated peristaltic activity of the underlying coils of bowel." The investigations of numerous observers is epitomized in an exhaustive study by Rubin.[86] Having reviewed the pertinent literature, he recorded a large series of observations made at cadaver, postmortem, and operation, and repeated under controlled conditions a variety of experiments previously performed by others. From critical evaluation of accumulated objective evidence, he reached the following conclusions: First, the omentum has no spontaneous mobility. Displacements may be explained by (1) intestinal peristalsis; (2) intra-abdominal tension; (3) static condition of the stomach, colon, and small intestines; (4) anatomic relationship to gallbladder and spleen. There is no demonstrable "chemotaxis," such as may bring the omentum up against gravity. This is the result of intraperitoneal fluid or gas, plus the suction action of the diaphragm.

Second, the omentum is not a superior organ with peculiar protective properties. Its usefulness in inflammatory lesions of the abdomen depends upon (1) its power to form adhesions which isolate and render toxic products innocuous; and (2) its power of absorbing and eliminating toxic products or destroying them by virtue of its phagocytic elements. Such protection as it apparently displays is simply due to its properties as peritoneum. As a peritoneal fold, it also assumes the mechanical function of a mesentery: the fixation of viscera and the transmission of a vascular supply.

*Mechanism of Omental Torsion.* The reason why abdominal organs and tumors undergo torsion is not well understood. Several theories exploring the etiology have been advanced, but few are worthy of

mention. Most of them, when reduced by analysis to a basic premise, dispose of the problem simply by comparing the structure to a moving wheel, where the outer rim travels further and faster than the hub. This is equivalent to the *ipso facto* statement that masses undergo torsion because they turn, without consideration of physical principles.

Expressed in mechanical terms, rotation is brought about either (1) by the action of a couple consisting of two forces which are equal, parallel and opposite, or else (2) of one force and a reaction which is a resistance operating in an opposite direction.[32] During axial rotation there is present at the site of torsion a resistant force, the "modulus of rigidity," which is directly proportionate to the actual and relative diameter of the neck or pedicle. This resistance increases enormously as the twists increase and become tighter. Having defined the dynamics involved, let us now consider the anatomic and physical factors which predispose to, or provide the "soil" for omental torsion.

First, there must exist "the absence of mechanical obstacles to rotation." The mass must be freely turnable, in a space and surroundings that will permit twisting. The mass should be smooth, of moderate size, and have an eccentric weight distribution. Such a mass in the peripheral omentum occurs frequently as a tumor or cyst, an inflammatory "ball," or a localized fat hypertrophy. Obesity, which is synonymous with the finding of fat hypertrophy, has been almost a constant finding in cases of primary omental torsion, while it also provides a relaxation of the abdominal wall sufficient for rotation.

Second, a long thin pedicle must exist. This may be present as a congenital or anatomic variation, or acquired either by the descent of a piece of the omentum into a hernial sac, or by the constant traction exerted by a relatively heavy distal part, especially in a dependent organ such as the omentum. Having specified the ideal mechanical "soil," let us now consider several possible precipitating physical forces, or "seed" for the production of omental torsion:

1. The application of external forces, including trauma, violent exercises, and other body movements: It is entirely probable that the maneuver of taxis, in reducing an omental herniation, can impart an axial twist to the hernial mass as it slips through the smooth funicular channel of the inguinal canal. The large percentage of cases coincident with inguinal hernia bears out this probability. The view that bodily movements might induce rotation is widely supported, under the mechanical principle that the distal mass continues the movement of turning even after the whole body has come to rest, because of the phenomenon of inertia. Bland-Sutton[9] is the authority for the statement that "a tumor hanging freely in the belly should, by mere alteration of the position of the body, or by motion imparted to it by a tumult of the bowels, spin around and twist its pedicle." Trauma[93,63,30] (blows, falls), lifting,[63,52,70,71] or violent exercise[79] have each been noted in conjunction with case reports, but there is no apparent mechanical basis for this association. Hertzler[45] aptly attributed "movements such as reaching across the table for more" as an etiologic factor, qualifying that "obviously it is the habitual reaching and not the individual act which is significant, that is to say, the patients habitually overeat."

2. Peristalsis: Peristalsis offers the most plausible postulate for the impetus to torsion. The passive omentum is constantly being tossed and rolled about, so that any local condensation or mass, especially at or near the free border, will repeatedly turn and untwist itself according to the pattern of peristaltic peregrinations. It must be understood that this force is not an isolated unusual incident that can precipitate torsion, but a constant repeated process. It is suggested by Fagge[32] that the required couple of forces for the rotation of an omental mass is provided when the mass intervenes between two adjacent coils of

intestine, or an intestinal coil on one side, plus the uterus or a lax abdominal wall on the other side, with a peristaltic wave as the motive force. Having come to this conclusion, Fagge[32] reflects that "if intestinal movements can produce omental torsion, why is it not more frequent?" The answer is obvious. The constant recurring tortious force involved must definitely exceed the modulus of rigidity and any other resistant forces to turning. This resistance and reaction to twisting tends to decrease as the physical conditions approach the ideal mechanical "soil" as previously described. When the balance of power favors the tortious forces, rotation is instituted. However, this superiority of force must be continued, since any slight advantage may soon be overcome. Olshausen presents clinical evidence that twisted pedicles frequently untwist spontaneously, and Morris[69] classified as "incomplete" those cases of omental torsion which had undergone spontaneous recovery.

3. The hemodynamic theory: This theory, as first advanced by Payr,[75] is a truly ingenious hypothesis. It depends on the anatomical fact that the veins are larger, longer, and more tortuous than the accompanying artery, and their walls are more easily compressible. Any physical change (kinking or twisting) will impede the venous circulation, and the veins will quickly become engorged. The artery, attempting to propel the blood against an increase in pressure, becomes a tense cord, like the string of a bow, about which the engorged, tortuous plexus of veins, attempting to accommodate themselves, wind around like a spiral. The tissue involved in this process of vascular dynamics must perforce follow its rotating vascular component, and thereby the whole mass undergoes torsion. Any degree of twisting compresses the venous return still further, perpetuating the insidious process. The added blood volume and the stasis in the twisted mass leads to edema, increasing the relative size and weight, which further predisposes to torsion. This vicious cycle can be broken only when the modulus of rigidity, which is increasing geometrically, catches up to and exceeds the torting forces.

Payr later published[76] a series of experiments endeavoring to prove that the cause of rotation was the change of pressure within the vascular system, especially the vein. Fagge[32] insisted that these conditions do not exist in the pedicle of a rotated mass, since both artery and veins are twisted. He pointed to the work of Adams,[1] who demonstrated that forces are set up which counteract the twisting couple when fluid under pressure is perfused through a twisted tube. This is illustrated in the untwisting and unkinking of the common garden hose during watering. Applying these dynamics to living structures, the pressure in the artery of the pedicle opposes forces which tend to twist it, and is, therefore, another natural protection against torsion. Fagge also points out that hemodynamics presupposes the existence of venous obstruction, which occurs only when rotation has already begun. However, the evolutionary assumption of an upright posture would expose the omentum, now a dependent structure, to the risk of venous congestion.[28] We might suggest the possibility that intestinal peristalsis could provide sufficient twisting of an omental mass under proper conditions for the institution of vascular dynamics.

*Surgical Pathology.* Either the whole omentum, or, more usually, only a portion (generally the right side) may undergo torsion. The direction of turning is clockwise,[24] which is apparently an inherent physiological trait.[68] The number of twists varies, depending principally on the configuration of the pedicle. Subsequent pathological changes are the result of local circulatory interference.

With the restriction of venous return, intravascular pressure within the distal mass rises to the level of systole, unless the arterial pressure has been previously cut off by the compression of the torsion itself. The rapid rise in intracapillary pressure

leads progressively to edema, diapedesis, extravasation of blood and an effusion of a considerable amount of serosanguineous fluid into the peritoneal cavity (or the hernial sac). The affected omental tissue has been undergoing a polychromatic deviation from its usual pale yellow, having become reddish with engorgement, dusky blue with congestion, and turning purple with extravasation, and black with gangrene.

Histologically, early stages show marked vascular engorgement with perivascular infiltration. Later, the essential finding is one of acute hemorrhagic infarction. The ensuing variety of cellular degeneration depends upon the rapidity and completeness of circulatory strangulation. A replacement fibrosis is found where strangulation is slow or incomplete. Stasis, intravascular thrombosis, and infarct formation follow total arrest of the circulation with resultant necrosis. The dead tissue acts as a foreign body, inducing inflammatory changes (contiguous parietal thickening, and hyperemia of adjacent structures), which may progress to an aseptic peritonitis. Organisms from adjacent bowel may penetrate to the necrotic mass, and the infection result in an abdominal abscess. In the absence of any infection, the mass may undergo atrophy, and rarely, absorption of the entire gangrenous mass may take place. More rarely still, the pedicle is auto-amputated, and the omental tumor, now a mendicant, supplements its disturbed nutrition by parasitic attachment to available peritoneum or adjacent normal omentum.

*Clinical Comments and Diagnosis.* Like other uncommon ailments, the diagnosis of omental torsion requires wide clinical experience and an astute mind. Andrews[4] listed seventeen intra-abdominal affections which it may simulate. In approximately 85 per cent of the cases reported, the preoperative diagnosis was appendicitis, but it is interesting to note that, of these cases, a McBurney incision was employed in about 15 per cent, indicating an element of doubt and a desire to be prepared for further exploration. Next in frequency of mistaken diagnosis was that of a diseased gallbladder, possibly because of the history of previous gastrointestinal upset. A preoperative diagnosis of a twisted ovarian cyst has also been made especially when a mass was noted on vaginal examination.[36, 101]

The true diagnosis might be suspected in the hernial type because of the previous history or the presence of a hernial mass. Even this faint clue is absent in the primary abdominal type, and the diagnosis is often made by intuition alone. Lejars,[56] Morestin,[67] and Payr,[76] among others, have been credited[69] with confirmed preoperative diagnosis. Having published a concise review of the literature on "Primary Torsion of the Great Omentum," D'Errico[24] felt justified in making definite diagnosis in a case[25] with which he was confronted shortly after. Smythe,[90] Jeffries,[50] and Andrews,[4] among others, prepared tables for the differential diagnosis from appendicitis, but there are no characteristic symptoms nor specific diagnostic aids which justify distinction except for a palpable intra-abdominal tumor mass. It must also be kept in mind that appendicitis may be the precipitating factor for intra-abdominal (secondary) omental torsion, and that both conditions might exist simultaneously.[78] Torsion occurring during pregnancy has also been reported.[14]

Swain[96] attributes the difficulty in differential diagnosis to "the fact that the early symptoms of acute abdominal trouble are generally the same, whatever the cause may be." He points out that abdominal symptoms are produced, not so much by the lesion itself (cutting or crushing the omentum is painless)[57] but by its peritoneal reaction, hence the similarity of early symptoms. Morely,[66] having observed that "the great omentum contains no afferent splanchnic nerve fibers capable of causing visceral pain when it is strangulated," concluded from his researches upon abdominal pain that in "cases of intra-abdominal torsion of the great omentum

the pain caused is entirely local and is due to contact between the swollen and infiltrated omentum and the sensitive parietal peritoneum."

Clinical symptoms, such as pain, nausea and vomiting, and physical findings such as tenderness, acceleration of the pulse, fever, and leucocytosis are really nonspecific pathologic manifestations of reflex sympathetic irritation responding to a physiologic pattern. The clinical syndrome is identical no matter what the cause and type of disorder may be, but its severity is proportionate to the intensity of (peritoneal) irritation produced.

Abdominal pain, sometimes mild, more usually severe, is the primary complaint. Its onset is usually sudden, although there is frequently a history of previous vague abdominal symptoms suggestive of subacute appendicitis or gallbladder disease. The pain is constant and does not radiate. The site of the pain is dependent upon the portion and proportion of the omentum undergoing rotation or torsion. Where the entire omentum is involved there is generalized abdominal pain, while, when only a portion undergoes twisting, the reaction is localized to the general area involved (almost invariably the right lower quadrant). The reason for this prediliction has been ascribed by various authors[8,69] to anatomic variations and congenital anomalies in this area, which undoubtedly favor torsion by providing ideal mechanical "soil" for twisting. However, the relative unimportance of this factor is demonstrated by statistical evidence as presented by Bernstein,[7] that, although ovarian tumors occur with almost equal frequency on both sides, yet ovarian torsion is twice as frequent on the right lower quadrant to the fact that, in addition to being the site of more frequent pathologic processes, it is the seat of greater physiologic activity, since intestinal peristalsis and changes in intra-abdominal pressure tend toward its direction. The clinical appearance and the severity of the pain depends somewhat upon the amount of omentum involved, but is mainly determined by the suddenness and extent of vascular obstruction. Although torsion is appreciated as a clinical entity in the acute phase only, there is ample evidence that axial rotation has either previously taken place or has been going on for some time. Symptoms are the result of vascular obstruction, and until this occurs, there are no complaints except vague abdominal discomfort, and no pathological changes are present. Moynihan is quoted[6] as stating that "rotation in the omentum (or other organs as the ovary with a cyst) does not occur suddenly; the acute change is not the twisting of the pedicle, but the thrombosis of the vessels which have long been twisted."

Nausea and vomiting are present in about half the cases. Absence of this symptom has been advanced by many authors as the differential criteria from appendicitis, but it has been noted in 50 per cent of the reported cases. Fever rarely exceeds a rise of one degree, and the occasional chill complained of may be accounted for on the basis of vascular thrombosis. The pulse may be slightly quickened. The leucocyte count is usually increased, varying from 12,000 to 25,000. High polymorphonuclear counts may be explained as due to the peritoneal irritation of the tumor and its henorrhagic exudate. Tenderness over the affected portion (usually the right lower quadrant) is present on deep palpation. Local superficial hyperesthesia may be present when the mass becomes adherent to the anterior abdominal wall. Local spasm and rigidity may also be found, dependent upon the stage and site of underlying disease.

One surgical sign which can be regarded as being specific for the diagnosis of omental torsion is the discovery, at an early stage in the disease, of a mobile, diffuse tumor mass, usually in the right lower quadrant. In order to utilize this diagnostic aid, the clinician must not only look for it, but he must possess a keen palpatory perception, since it is usually obscured by local rigidity, distention, and obesity. A similar

mass, fixed and extremely tender, developing after several days, is indicative of an appendicular abscess. If the abdomen is examined in omental torsion, the mass is further obscured by an appreciable amount of intraperitoneal fluid, which may be detected by appropriate clinical technics. It has also been claimed by some authors that percussion over the right lower quadrant in acute appendicitis produces resonance distinguishable from the dullness elicited in omental torsion.

The incidence of omental torsion is greatest in the middle-aged, although individual cases from all decades have been reported. Its predominance in the male is marked, and even in the primary type the incidence is 22 males to 9 females. If the cases secondary to inguinal hernia are included, the ratio is further increased. The three cases reported in our series are all males. With very few exceptions, obesity is characteristic of the patient with torsion. Morris[69] describes this adipose figure as the "torsion habitus." Our own cases conform to this body type.

*Treatment.* If the preoperative diagnosis of omental torsion is ventured, laparotomy must be performed for confirmation and correction. In our opinion, a right paramedian sub-umbilical incision provides the best approach for investigation and operative accessibility. Upon opening the peritoneum, a considerable amount of serosanguineous transudate will be found, depending upon the size of the mass, the stage of circulatory obstruction, and the time elapsed before operation. Andrews[4] considers that "the presence of bloody fluid (upon opening an abdomen) makes the search for an omental torsion mandatory."

The appearance of the affected area of the omentum (as described under surgical pathology) depends upon the degree of circulatory obstruction and the length of time elapsed before operation. Its texture has been compared to "a sponge which has been left inadvertently in the abdomen," and also to "wet paste-board." The actual size of the twisted mass is enlarged by hemorrhage and edema. Structures adjacent to the twisted mass will naturally undergo mild inflammatory changes and a perfunctory surgeon may be led astray by the false scent of a hyperemic appendix or gallbladder and regard it as the primary culprit. In those cases in which the appendix or gallbladder is accused and an omental torsion is not even suspected, the innocent organ may be removed and the omentum overlooked entirely. The postoperative persistence of a tumor will be erroneously regarded as an inflammatory mass unless the rotated portion of the omentum is discovered, followed centralward, and the diseased portion removed surgically.

It is unwise (and in violation of elementary surgical precepts) merely to unroll the twisted portion and restore it to the peritoneal cavity. Even if the entire omentum is involved, it should be removed without hesitation *in toto*, by ligating sections individually along the proximal border. Draper and Johnson,[28] having performed over 200 total omentectomies without an attributable mortality, believe that "this recessive structure (the omentum) should receive the same surgical consideration accorded to any tissue which has become useless and menacing through any combination of disuse and disease." During its removal, the diseased portion should be handled gently to prevent dislodging any thrombi into the circulation. The remainder of the abdomen should be searched for concomitant disease, which may also shed some light on the etiology of torsion. The hernial orifices should especially be examined. Drainage is unnecessary. Unless there are complicating factors so indicating, there is no reason to insert any of the sulfonamides.

Operation should be performed promptly. Procrastination is unwise. Delay results only in more toxic absorption from the necrotic, diseased mass, an increase in peritoneal irritation with the development of peritonism, and the formation of local adhesions. It invites the inception of complications. Mechanical intestinal obstruc-

tion has been traced to omental torsion on autopsy and laparotomy.

Either septic or aseptic peritonitis may develope, depending on the fate of the necrotic portion. In one case[104] it was found to have withered, so "it would be impossible to estimate how long the mass would have taken to disappear." Aseptic sloughing with the evolution of an intraperitoneal free foreign body is also possible. Auto-amputation of the twisted omentum has been discovered at laparotomy with the diseased mass adherent to some distant structures interfering with their functions.

Mortality and morbidity in the uncomplicated cases with early operation is practically nil.

## CASE REPORTS

Case 1. (Chart No. 86092). A. R., a thirty-two year old white, married, male, was admitted to the hospital on September 9, 1937, complaining of right lower quadrant pain radiating toward the midline, of two weeks' duration. The past history was essentially negative except for a previous admission to the same hospital two years ago. At that time the patient had an incarcerated left inguinal hernia of twenty-four hours' duration. The sac contained a piece of omentum which was incarcerated and the omentum was returned to the abdomen *in toto*.

The present illness began twelve days prior to admission, with sudden onset of cramps in the right lower quadrant while the patient was at work. There was no nausea or vomiting. Bowel movements were normal. The patient took a bottle of citrate of magnesia which aggravated the abdominal pain. The following day the patient felt better and continued thus until three days before admission to the hospital. At this time he was again seized with severe right lower quadrant pain associated with nausea and vomiting, which was followed by chills and fever on the following day. The pain radiated to the midline and there was an associated dysuria.

On admission the patient was acutely ill. He was obese, lips parched, tongue dry and coated. Heart and lungs were normal. Abdominal examination revealed a left healed inguinal hernia incisional scar which was not tender, with no evidence of a recurrent hernia. The entire lower abdomen was spastic, more so on the right side with marked tenderness over the right McBurney's area. No masses could be palpated because of obesity, but there was dullness on percussion over the right lower quadrant. There was no evidence of hernia in the right inguinal region. Rectal examination revealed a bogginess in the right side high up. The following data were obtained on admission: Temperature, 101.8°F., pulse, 100; respiration, 24; blood pressure, 134/74; red blood cells, 5,000,000; hemoglobin, 90 per cent; white blood cells, 15,900; polymorphonuclears, 92 per cent; monocytes, 8 per cent, and the urine was normal.

A diagnosis of acute appendicitis was made and after correcting the patient's fluid and electrolite balance the patient was prepared for surgery.

Under spinal anesthesia the abdomen was entered through a right lower transrectus incision. Exploration of the abdomen revealed a moderate amount of serosanguineous fluid and a large purplish mass rolled into a ball occupying the right illiac fossa. Following this mass cephaloid it was found to be twisted in the middle of its long axis and was suspended by two cord-like structures about ⅛ inch in diameter from the greater curvature of the stomach. Through these cord-like structures ran good sized blood vessels. The entire mass was easily separated from its location by finger dissection and exteriorized and the suspending connecting cords were clamped, cut and ligated with No. 2 catgut sutures. The tumor mass was the entire great omentum. The appendix was retrocecal, retroperitoneal and removed as a routine measure.

The patient had a moderate postoperative reaction which lasted two days and the remaining stay in the hospital was entirely uneventful. The patient was discharged from the hospital on the twelfth postoperative day in excellent condition.

The specimen consists of the great omentum, double layered which is more than 15 by 14 inches in size. At one end it is rolled and indurated, dark, deeply hemorrhagic and section here reveals extravasated blood into the loose tissues and vessels plugged with blood clot. The major portion, however, is still fine and delicate, though here, too, vessels hold blood clot.

The vessels are all markedly distended with red blood cells, and a few also hold fibrin. The tissue is the seat of extensive extravasation of blood. *Diagnosis:* Hemorrhagic infarction of the omentum. The section of the appendix did not show any inflammatory infiltration.

Case II. (Chart No. 92985). D. Z., an eighteen year old single male, was admitted on October 2, 1938, complaining of dull periumbilical pain, nausea and vomiting of four days' duration. On the day of admission the pain localized in the right lower quadrant with increasing severity. Family and past history were essentially negative. On examination the patient did not appear acutely ill. The abdomen was soft and not distended with no masses palpable. There was tenderness and spasm over the lower right rectus, more marked over the right McBurney point. The blood count showed a leucocytosis, viz., white blood count, 13,076; polymorphonuclears 76 per cent; monocytes 24 per cent, and the urine was normal.

Operation was performed on the following day for an acute appendicitis. Under spinal anesthesia, the abdomen was opened through a lower right paramedian incision and the following operative findings were recorded: The lower pole of the great omentum had three twists, clock-wise, involving the omentum for about 4 inches. It was edematous and hemorrhagic. The appendix was distended and in the middle of the appendix was lodged a foreign body about ¾ inch long and ⅜ inch wide, resembling half of a prune pit. The involved omentum was resected and the appendix removed. The postoperative course was uneventful and the patient discharged from the hospital on the eleventh day postoperatively, with wound healing by primary union.

The specimen consists of a piece of omentum 10 by 8 cm. and 1½ cm. thick, dark red, thickened with vessels distended with blood. The appendix is 6 cm. long, 0.5 cm. in external diameter. The serosa is glistening, the wall 1 to 2 mm. thick. The lumen holds hemorrhagic material, and two pieces of foreign material, one a soft piece of what looks like orange seed, another larger piece, about 1 cm. long, a few mm. wide, part of a hard fruit seed. The mucosa is for the most part intact.

*Microscopic findings:* Omentum section shows vessels distended with blood and early thrombus formation. There is extensive extravasation of blood, and a polymorphonuclear reaction. The appendix sections show no inflammatory infiltration. *Diagnosis:* Hemorrhagic infarction of omentum; appendix with foreign bodies in lumen.

Case III. (Chart No. 109650). S. S., a forty-eight year old white male, was admitted to the hospital on December 11, 1940, complaining of severe right upper quadrant pain of three days' duration. The family history was not contributory and except for malaria twenty-five years previously, the past medical history was entirely negative. Previous gastrointestinal disturbances (flatulence, postprandial distress, etc.) were denied.

The present illness began three days before admission, when the patient arose with some slight pain in the right upper quadrant. He ate well and had a good bowel movement, but the pain increased in severity as the day went on. The patient had some nausea and as the pain increased in severity the patient found it "hard to breathe."

Examination revealed a well nourished white male, lying in bed with acute distress in the right upper quadrant. Abdominal examination elicited tenderness, spasm and a sensation of a palpable mass in the right upper quadrant. A diagnosis of acute cholecystitis was made and the patient prepared for surgery.

His temperature was 100.4°F.; pulse, 88; respirations, 20; blood pressure 124/75; urine normal; red blood cells, 4,220,000; white blood cells, 13,350; hemoglobin, 94 per cent; polymorphonuclears, 88 per cent; monocytes, 12 per cent; blood chemistry essentially normal.

Under spinal anesthesia, a right rectus incision was made, and on opening the celomic cavity a large piece of twisted omentum, about 5 inches long presented itself which was of granular consistency with engorged blood vessels. There was a moderate amount of serosanguineous fluid in the abdominal cavity. Further exploration revealed the liver to be enlarged, the gallbladder compressable, normal in size and appearance, and the stomach, intestinal tract including appendix all appeared normal to palpation and vision.

The omentum was clamped above the twisted portion and excised distal to clamp. A suture ligature was applied and the clamp removed. The abdomen was closed in layers. The patients recovery was uneventful.

Pathologic report: Hemorrhagic infarction of omentum.

SUMMARY

1. Three cases of intra-abdominal omental torsion are reported.

2. This is a clinical entity which is neglected unjustifiably in the differential diagnosis of an acute condition of the abdomen with obscure etiology. Not only is a preoperative diagnosis rare, but it is hardly ever considered in clinical surgery.

3. A brief review of the omentum is given, outlining its embryology, phylogeny, histology, anatomy, and physiology.

4. Several theories explaining the etiology and mechanics of omental torsion are presented.

5. The pathology of omental torsion is briefly reviewed, and the differential diagnosis, treatment, and prognosis discussed.

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# INTERCOSTAL NERVE BLOCK IN BALANCED ANESTHESIA*

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THE science of anesthesiology has made tremendous strides in the last few decades after a long period of relative inertia. After the first use of ether by Long in 1842, for the next fifty years the only agents used were for inhalation, nitrous oxide, ether, and chloroform being the most widely known. At the turn of the century, Bier opened a new field when he demonstrated the possibility of the subarachnoid injection of cocaine for the production of anesthesia of a group of spinal nerves. In the present era, Labat has been the great exponent of regional anesthesia produced by local infiltration of the nerves supplying any specific area. The intravenous injection of ultra short acting barbiturates and refrigeration by ice are perhaps the newest methods of producing anesthesia. From the original armamentarium of one agent, the anesthetist now has a great many agents and methods at his disposal, and it is his duty to select the best anesthetic for each individual patient.

Lundy,[1] in 1926, first coined the term "balanced anesthesia" to indicate the use of a combination of anesthetic agents and methods so balanced that the burden of pain relief and the production of conditions compatible with surgery are not borne by any one method but rather by the combined effects of several. This principle has long been in use. The addition of ether vapor to a mixture of nitrous oxide-oxygen was one of the earliest examples of the use of a combination of anesthetic agents. The use of sedatives, as opiates, in the preoperative period tends to allay fear and apprehension and decreases the amount of anesthetic agent needed. Rectal anesthesia with avertin fluid (tribomethanol in amylene hydrate) partially anesthetizes the patient and greatly decreases the amount of inhalation agent needed. Under spinal anesthesia, a light cyclopropane or nitrous oxide-oxygen analgesia relieves nausea and pain from traction on visceral attachments. Sodium pentothal can also be used for this purpose.

In the average good risk patient almost any anesthetic procedure, if in the hands of an experienced and trained anesthetist, will produce satisfactory results. In the group of poor risk patients, however, on whom desperate and emergency surgery is being done, the subject might not stand large doses of any one agent, and it is here that the use of balanced anesthesia is of great value.

## TECHNIC

The first step in the production of balanced anesthesia is the proper preoperative preparation of the patient. These people are usually acutely ill and very often belong to the older age group. The preoperative use of intravenous fluids, oxygen, and other supportive measures are beyond the scope of this paper. We will concern ourselves only with the sedation necessary for the proper functioning of the anesthesia.

A very careful estimation of the patient's strength and condition must be made and enough medication given to produce a sleepy, drowsy patient without overdosage. Nembutal gr. 1½ by mouth and morphine sulphate gr. ⅛ to ⅙ with scopolamine hydrobromide gr. 1/200 to 1/150 by hypodermic, all given one hour preoperatively, have proved very satisfactory in producing sufficient sedation without undue depression. The nembutal also helps ward off any

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toxic effects of the procaine. An awake, apprehensive patient is a poor subject on whom to start a procedure such as this.

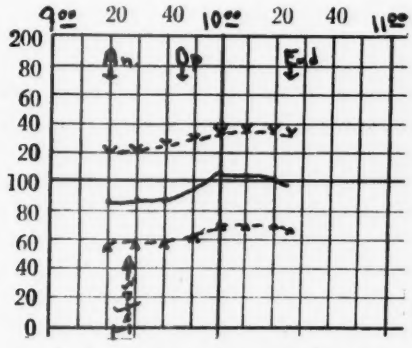


Fig. 1. Anesthesia record in Case I.

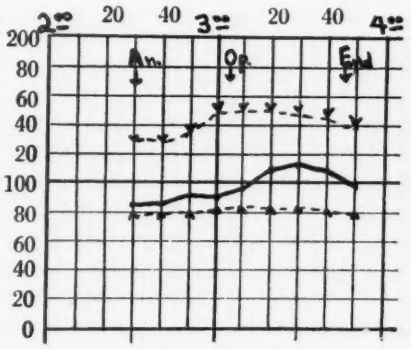


Fig. 2. Anesthesia record in Case II.

Upon arrival in the operating room, the intercostal block is done according to the technic described by Bartlett.[2] The skin is surgically prepared with any suitable antiseptic solution and draped with sterile towels. Preliminary skin wheals are raised with 1 per cent procaine over ribs seven through eleven in the midaxillary line. It is here that the intercostal nerves run in a closed compartment between the internal and external intercostal muscles and are easily accessible. From 3 to 5 cc. of 2 per cent procaine solution are deposited in each interspace just under the internal surface of the rib after careful aspiration has been done to ascertain whether or not the needle has punctured the pleura or is in one of the intercostal vessels. The procedure is carried out on both sides, and when one has achieved a fair degree of dexterity it should not take more than a few minutes. The surgeon must now wait from five to ten minutes until the anesthesia has set in as evidenced by loss of sensation to skin stimuli and relaxation of the musculature of the abdominal wall. When satisfactory, the operation can be started, and the patient put to sleep while the skin and fascia are being incised and before the peritoneum is opened. At first the block was done under local infiltration anesthesia, but the procedure was quite disturbing to the patient, and in subsequent cases, when feasible, the general anesthesia was started first. This is not done, however, when using sodium pentothal as the supplementary agent.

The regional block can be supplemented by either inhalation or intravenous anesthesia, just enough of the agent being given to put the patient to the lower first or upper second plane of third stage surgical anesthesia (after Guedel[3]) in order to eliminate pain from traction on the abdominal viscera. Relaxation has already been obtained through the nerve block. In three of the cases used for illustrative purposes Novest-Oil was used instead of procaine. Novest-Oil is an oily solution of monocaine which is now being investigated as an agent for producing prolonged anesthesia of the upper abdominal wall by means of intercostal block. With this oily solution the onset of anesthesia is delayed about twenty minutes, which time is usually taken to prepare and drape the patient and incise to the peritoneum.

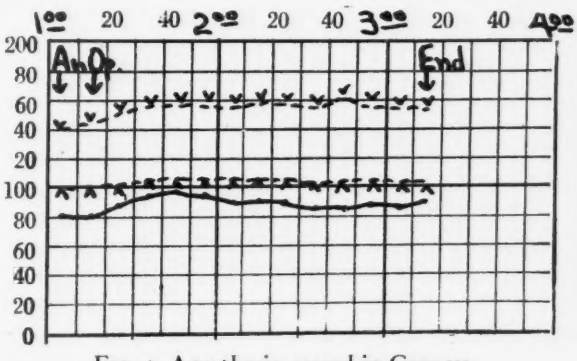


Fig. 3. Anesthesia record in Case III.

This use of balanced anesthesia has found favor with the surgeons since it pro-

vided excellent working conditions in every instance with minimal depression of the patient. The wide variety of available agents gives the method great flexibility. The examples in the case reports show the different combinations that can be used.

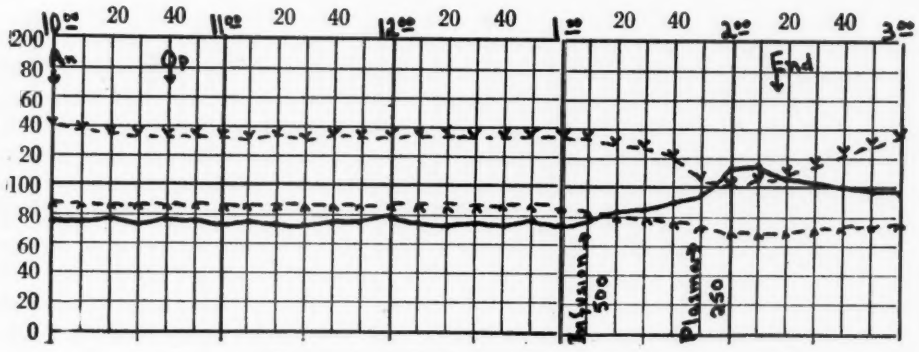


FIG. 4. Anesthesia record in Case IV.

## CASE REPORTS

CASE I. B. B., a sixty-five year old, swarthy, markedly jaundiced, white male in very poor condition with a high spiking temperature and deranged fluid balance was admitted with a diagnosis of upper abdominal abscess of unknown etiology, and an exploratory laparotomy was decided upon.

Premedication of nembutal gr. 1½, morphine sulfate gr. ⅙ and scopolamine hydrobromide gr. 1/200 was given at 8:30 A.M. Intercostal block with procaine, 2 cc. of 2 per cent at T7 through T11 bilaterally, was done from 9:15 to 9:25 A.M., and after an infusion of 5 per cent glucose in saline was started at 9:30 A.M. and nitrous oxide-oxygen 50 per cent at 9:35 A.M., the patient was prepared and draped, and the operative procedure started at 9:45. The operation consisted of opening the abdomen through an upper right rectus incision, evacuating as much pus as possible, insertion of several drains, and closure, completed at 10:25 A.M.

The anesthesia was satisfactory from the surgeon's point of view, and the patient was in as good condition at the end as when he started. The patient was kept lightly asleep, and if necessary for any extensive operative procedure, the anesthesia could readily have been deepened. There was no depression from the anesthetic and no shock.

CASE II. C. J., a fifty-four year old, deeply jaundiced white female with hypertensive heart disease, coronary sclerosis, and right bundle branch block was transferred from the medical service for exploratory laparotomy.

Premedication of nembutal gr. 1½, morphine sulfate gr. ⅙, and scopolamine hydrobromide gr. 1/150 was given at 1:45. General anesthesia with nitrous oxide-oxygen and ether vapor started at 2:30, and bilateral intercostal block with 1½ cc. Novest-Oil at each interspace from T6 through T11 was done from 2:35 to 2:45. The incision was made at 3:05, an inoperable carcinoma of the gallbladder with metastasis to the liver was found, and after biopsies were taken the wound was closed and the patient returned to her room in excellent condition.

Due to the relaxation obtained from the regional block, the patient was not put any deeper than the upper second plane of surgical anesthesia and was reacting on her return to the room. The advantages of a minimal dose of anesthetic agent are great in severe liver disease.

CASE III. J. R., a sixty-six year old, obese, white female with hypertensive heart disease, arteriosclerosis, bronchiectasis, and a draining fistula from a cholecystostomy for empyema of the gallbladder one year previously was admitted for cholecystectomy and common duct exploration.

Premedication of morphine sulfate gr. ⅙ and atropine sulfate gr. 1/150 was given at 11:00 A.M. Under local infiltration anesthesia with 1 per cent procaine bilateral intercostal block from T6 through T11 with 2 per cent procaine was done from 12:50 to 1:05 P.M. The incision was made at 1:15 P.M. and immediately after general anesthesia with a cyclopropane-oxygen mixture was begun. The patient was kept lightly asleep in the lower first plane of surgical anesthesia until the skin was closed at 3:15 P.M. She reacted very quickly,

speaking rationally by the time she was placed in bed. The operation consisted of cholecystectomy and removal of a large impacted stone in the common duct.

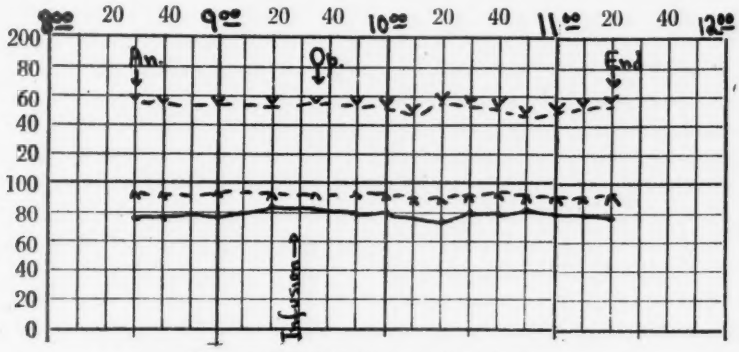


Fig. 5. Anesthesia record in Case v.

The anesthesia was perfect in that there was complete upper abdominal relaxation, respirations were thoracic in nature with quiet abdominal contents, and the condition of the patient did not change during the operative procedure.

Case iv. C. H., a sixty-three year old, white, obese female in good condition with blood pressure 140/90 was admitted for cholecystectomy and common duct plastic.

Premedication of morphine sulfate gr. $\frac{1}{6}$ and scopolamine hydrobromide gr. $\frac{1}{150}$ was given at 9:15 a.m. General anesthesia with nitrous oxide and oxygen was started at 10 a.m. and bilateral block of intercostal nerves T6 through T11 done from 10:05 to 10:15 a.m. with 1½ cc. of Novest-Oil at each space. At 10:20 a.m. ether was added to the anesthetic mixture, the patient induced to the second plane of surgical anesthesia and intubated at 10:30 a.m. The operation was started at 10:40 a.m. and completed at 2:15 p.m. After three hours of anesthesia the pulse rate began to rise and the blood pressure fell. This was effectively combated with an infusion of 500 cc. of saline followed by 250 cc. of plasma. The patient reacted on the way from the operating room to her bed.

The advantage of this combination of agents was commented upon by the surgeon. The block afforded complete relaxation, and the intubation resulted in quiet breathing which was thoracic in nature since the anesthesia was maintained in the upper second plane and diaphragmatic excursions were not accentuated. The end result of the combination was an abdomen similar to that found with spinal anesthesia, without its dangers. Novest-Oil was used since a sufficiently long block could not be obtained with procaine.

Case v. E. G., a sixty-four old obese, white female with hypertensive heart disease, enlarged heart, blood pressure of 168/90 and generalized arteriosclerosis was admitted with obstruction from carcinoma of the stomach. She was considered a poor operative risk, and a balanced anesthetic procedure was decided upon.

Premedication with morphine sulfate gr. $\frac{1}{6}$ and scopolamine hydrobromide gr. $\frac{1}{150}$ at 7:30 a.m. rendered the patient sleepy when she came to the operating room, and under local infiltration with procaine 1 per cent, intercostal block from T6 to T11 bilaterally with 1½ cc. of Novest-Oil at each space was done from 8:30 to 8:55 a.m. An infusion was started at 9:30 a.m., and when skin anesthesia of the upper abdomen was present at 9:35 a.m., the incision was made. At 9:40 a.m. the patient was put to sleep with a 2½ cc. solution of sodium pentothal injected into the intravenous tubing, and immediately thereafter the mask of the anesthetic machine was applied to the face and a 50:50 mixture of nitrous oxide and oxygen was administered. The carcinoma was not resectable, and a gastroenterostomy done. The operation was concluded at 11:20 a.m. with the patient in excellent condition.

The use of the nitrous oxide-oxygen mixture with sodium pentothal served several purposes. First, the amount of pentothal needed was markedly decreased, only 50 cc. of 2½ per cent solution (1.25 Gm.) being used in a two-hour procedure. Secondly, the use of the anesthesia machine provided an effective way of measuring the depth of respiration and level of anesthesia by watching the excursions of the rebreathing bag. Third, the 50 per cent oxygen

content of the mixture was considerably more than can be obtained from atmospheric air.

## COMMENTS

To produce the muscular relaxation demanded by the surgeon when working in the upper abdomen, it is necessary to give a large amount of any anesthetic agent. In the case of sodium pentothal intravenously, this relaxation is unobtainable without approaching much too closely a toxic dose. There results a profound depression with deleterious effects upon the patient and his subsequent postoperative course. It has proved unsatisfactory when used alone.

The use of inhalation agents as ether or cyclopropane to produce adequate relaxation necessitates at least lower second or upper third plane third stage anesthesia (after Geudel). This level, in a patient in poor condition, is undesirable since the patient is frequently unable to maintain his cardiorespiratory system either during the operation or in the immediate postoperative period and sinks rapidly. Even if able to cope with the depression caused by the anesthetic and operative procedure, the postoperative course often is stormy.

In an excellent paper published recently by Evans[4] while this study was being made, he pointed out the advantages of intercostal block with procaine combined with intravenous sodium pentothal in traumatic injuries of the abdomen when shock in varying degree was present. His studies were undertaken in an effort to find a suitable anesthetic for use by the military forces in the field where facilities were limited. The results of this valuable investigation showed that in this type of gravely ill patient, excellent anesthesia with minimal depression was obtained with the use of this combination. This controlled group of cases was done under conditions approximating as closely as possible those to be found in actual combat.

In our civilian hospitals working with all modern conveniences, this concept of balanced anesthesia can be carried further than was done by Evans, using both his combination and the others already illustrated. It has been used here in combination with sodium pentothal, nitrous oxide, cyclopropane and ether. In one of the cases the inhalation agents were delivered by the endotracheal route, the patient being anesthetized just deeply enough to tolerate the presence of the tube in the trachea.

If for some reason the intercostal block does not produce the desired relaxation, nothing is lost, for then the anesthesia can be deepened to the required level using the inhalation agent. The great flexibility of the method giving the anesthetist complete control of the patient is especially desirable. The supplementary agents can be varied to meet the requirements of the individual case and can be changed during the operation should the necessity arise.

The method should not be restricted only to the gravely ill. Any patient who is operated upon should receive the benefits of the addition of intercostal block to the anesthesia if there is the slightest question of his ability to stand the anesthesia and operation, or if the abdominal relaxation desired by the surgeon will not be safely obtained with the anesthetic agent to be used.

## CONCLUSION

A discussion of intercostal nerve block as a regional anesthetic to be used in conjunction with other agents in the production of a balanced anesthetic has been presented, and its merits in poor risk and other patients having upper abdominal operations considered. Typical case reports showing the application of balanced anesthesia have been given.

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# OPERATION FOR ANAL FISTULAS

## SOME REASONS FOR FAILURES

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ALTHOUGH the earliest records of medical history describe a relatively satisfactory operation for anal fistula, the fundamentals of which are still in use, there are probably few surgical procedures in which there is as high a percentage of failures.

A review of the records of 500 patients who came to the Mayo Clinic because of an anal fistula, or more specifically a draining sinus in the perianal, anal, or rectal region, disclosed that 43 per cent or nearly half of them previously had undergone from one to fourteen operations that had been unsuccessful.

The most frequent causes of the failure of operation to eradicate an anal fistula are as follows: (1) faulty conception of the origin and course of the disease, (2) confusion in regard to the anatomy, (3) confusion in regard to the terminology, (4) mistaken diagnosis, (5) fear of causing rectal incontinence, (6) inadequate postoperative care, (7) failure to appreciate the danger of performing anorectal operations in the presence of infectious diarrhea, (8) inadequate anesthesia and (9) lack of teaching facilities in medical schools.

### FAULTY CONCEPTION OF THE ORIGIN AND COURSE OF AN ANAL FISTULA

Almost all anal fistulas arise in a crypt at the dentate margin. Buie has described the following stages in the development of an anal fistula: (1) infection of a crypt of Morgagni; (2) extension of the infection along the course of least resistance, usually into the loose areolar tissue of the ischioanal fossa; (3) tissue necrosis and abscess formation; (4) spontaneous rupture of the abscess. In a great majority of complete anal fistulas, this sequence of events is true. However, an anal fistula may have as its primary source an ulcer or a fissure in the anal canal, but usually, in this event, it is a subcutaneous fistula. The primary or anal source of the fistula may be sufficiently large to permit the products of inflammation to drain back through it, thus obviating the necessity of a secondary opening and therefore resulting in an incomplete internal or external fistula, depending upon the course the abscess has taken. A fistula very occasionally may originate in the rectum itself, that is, proximal to the pectinate line, and progress from there to its secondary opening, in which event, however, it is no longer an anal but a rectal fistula.

### CONFUSION IN REGARD TO THE ANATOMY

It is a rare exception to read an article on anal fistula which does not go into great detail about the anatomy of the anal sphincters, particularly as to whether the external anal sphincter is composed of one, two, or three bundles. For didactic purposes, this may be perfectly well and good, but usually the same article will elaborate on whether or not, in the surgical treatment of the fistula, it is safe to cut one or all of the bundles. This is entirely beside the point, and the rules laid down by John Arderne more than 500 years ago still hold true, that is, to open the fistulous tracts from their source to their termination, regardless of how much muscle intervenes.

Perhaps another cause for confusion in regard to the anatomy is the variation of boundaries given by different authors for the limits of the anal canal. Some give the lower limit of the prostate gland but the majority use the pectinate line. The latter would seem much more logical from an

embryologic standpoint (that is, the junction of hindgut and proctodeum), as well as from the standpoint of the origin and spread of disease.

### CONFUSION IN REGARD TO TERMINOLOGY

Based on the sequence of events in the development of a fistula, Buie has suggested a substitution of the term "primary opening" for internal opening and of the term "secondary opening" for external opening. This terminology would seem much more logical, since it is based on the course of development of the fistula and also because the term "external opening" would signify that the opening is on the outside or external part of the body, whereas, as a matter of fact, the external, or, more properly, the secondary opening, may be inside the rectum proximal to the dentate margin. Based on this terminology then, an internal fistula is one in which the primary source is in a crypt at the dentate margin and the secondary opening is proximal to the dentate margin. An external fistula is one with a similar primary source; however, the pus follows a course to the outside of the body and the secondary opening is distal to the dentate margin, usually in either ischio-anal fossa. An incomplete internal fistula or an incomplete external fistula is one in which no secondary opening has been established, principally because the drainage of pus back through the primary source is adequate to relieve the pressure. Strictly speaking, incomplete internal fistulas and incomplete external fistulas are actually not fistulas but chronic abscesses, since the word "fistula" is derived from the Greek word meaning "pipe," and connotes a primary and secondary opening. Buie has suggested that the terms "incomplete internal fistula," "incomplete external fistula" and "blind fistula" should be discarded. The respective lesions should be designated as sinuses or abscess cavities.

### MISTAKEN DIAGNOSIS

By far the most common cause for a draining sinus at or near the anus is an anal fistula. It is by no means true that all draining sinuses in this area are fistulas, and if one will keep in mind the other possibilities, much time and grief may be spared in looking in the anus or rectum for the primary source of a perianal sinus which does not exist. Smith[3] has classified the conditions which may cause draining sinuses in this area into four groups:

*Group* 1. This group includes those sinuses which are the result of spontaneous pyogenic inflammatory processes, such as (1) fistula in ano, (2) incomplete fistula or an abscess cavity, (3) sinus or fistula associated with fissure, (4) rectovaginal fistula which may and frequently is an anal fistula, (5) infection of the lymph vessels and (6) peri-urethral abscess. The term "rectovaginal fistula" is used loosely; the lesion usually is an anovaginal fistula.

*Group* 2. This group includes those sinuses which arise from normal or abnormal glands, from abnormally situated glandular tissue or from cystic lesions such as pilonidal cysts, chromaffin bodies, multilocular cysts, Bartholin cyst abscesses, pyoderma or hidradenitis suppurativa and dermoid cysts.

*Group* 3. This group includes those sinuses which are the result of specific or peculiar etiologic agents or gross injury such as tuberculosis, actinomycosis, osteomyelitis, penetrating injuries, lymphogranuloma inguinale and malignant lesions such as carcinoma, epithelioma and lymphogranuloma.

*Group* 4. This group includes pseudosinuses caused by superficial embryologic abnormalities or pathologic alteration of normal structures such as congenital anal dimples situated anteriorly or posteriorly, postanal dimple, comedones and great enlargement of hair follicles.

It is not the purpose of this study to go into the differential diagnosis, but Smith's outline of some of the processes which cause chronic anal or perianal sinuses serves to illustrate why any sinus in the perianal region should not be considered to be an ordinary anal fistula. However, one condi-

tion in group 2, namely, pyoderma or hidradenitis suppurativa, is being recognized more frequently. In the past this disease probably was diagnosed as so-called incomplete external or blind external fistula. It is now established that it is a disease of the apocrine sweat glands and the lesion usually does not communicate with the anus at all. If one remembers that the apocrine sweat glands are found in the skin of the perianal, inguinal, axillary and mammary regions and that more than one of these regions usually is involved, the differential diagnosis will be less difficult and much time saved in looking for the primary source of a fistula which does not exist.

### FEAR OF CAUSING THE PATIENT TO BE INCONTINENT

Surgeons see many cases in which scars or wounds of previous surgical operations are present in the perianal region. Surgeons fear to cut through the muscle because of the danger of producing an incontinent anus. If the fistula is to be cured, the old rule still holds; namely, that all the tissue overlying the fistulous tract must be incised whether or not muscle intervenes. One of the chief causes of incontinence of the anal musculature is the custom of packing the incised fistula wide open, thereby causing a wide scar which prevents the remaining anal muscle from closing the anal orifice. Another reason for anal incontinence is permitting the inflammatory process to continue without treatment. In so doing, much more scar is formed and muscle tissue itself is destroyed by the pathologic process.

### INADEQUATE POSTOPERATIVE CARE

Any anorectal wound should be regarded as a contaminated or infected wound and treated accordingly with hot moist packs, hot irrigations and daily inspection of the wound to prevent bridging of tissue. Thinking of the postoperative treatment at the time of operation by attempting to create flat, open wounds which do not block the drainage is important.

### FAILURE TO APPRECIATE THE DANGER OF ANORECTAL OPERATIONS IN CASES OF INFECTIOUS DIARRHEA

It previously has been shown that an anal abscess or fistula occurs as a complication in a relatively high percentage of cases of chronic ulcerative colitis,[4] regional ileitis[2] and amebic dysentery. A surgical procedure on the anus is not desirable in such cases; for the most part, it should be limited to incision and drainage of abscesses. If any anorectal operation is done, it should be performed during a quiescent stage of the disease and even then it is liable to cause an exacerbation of the diarrheal disease. The wounds will heal very slowly.

### INADEQUATE ANESTHESIA

Not an insignificant cause of failure of operations for anal fistula is poor anesthesia. In order to examine the anal canal adequately and determine the site of the primary source of the fistula, complete anesthesia of the anal musculature is usually necessary. For this purpose, caudal anesthesia and sacral block approach the ideal. If general anesthesia is used, it must be very deep. With local anesthesia, complete relaxation is difficult to obtain.

### LACK OF TEACHING FACILITIES IN MEDICAL SCHOOLS

Certainly not the least important reason for the failure of operations for anal fistula is the lack of emphasis placed on the subject of proctology in the various medical schools of this country. If a proctologic department exists in a medical school, a very limited part of the curriculum is given to instruction in this specialty.

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# FIXITY OF FACIAL EXPRESSION FOLLOWING UNDERMINING OF THE SKIN OVER THE NOSE*

## A MODIFIED METHOD BY WHICH IT IS AVOIDED

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FOLLOWING plastic operation on the nose, especially that for correction of hump, there occurs, after a varying interval of weeks, a mask-like lack of mobility of the tissues involved in the operation, which closely resembles in character that seen in patients with myxedema.

The presence of this condition is recognized both by the patient and others, and it thus becomes a factor of importance from several points of view, both for patient and operator. Depending upon the personality of the individual, even a temporary facial blemish of this sort may exert a particularly undesirable influence both socially and economically, and at best such an operative result requires emotional adjustment. This is usually more difficult because of the nature of the operation. Few patients wish to have the fact of a cosmetic operation publicized, when it does not arise from a deformity due to injury or disease, and the considerable length of time required for the re-establishment of normal tissue function is of special importance in this relation.

If the detail of the operation commonly employed for removing hump of the nose is examined, a cause for the occurrence of such a myxedematous appearance of the tissues will be made clear.

A button-end scalpel is passed through the left incision and carried directly over the nasal dorsum; then directed downward until it appears through the opposite nasal incision, where it is turned at right angles, following the course of the caudal part of the septum almost to the nasal spine.

To remove the hump, a nasal saw is introduced through the primary incision and is placed flush with the hump at the level at which the reduction of the profile is to be made. The forefinger and the thumb of the non-operating hand are placed on the side of the nose to protect the overlying skin.

The body and cartilaginous nasal elements and the perpendicular plate of the ethmoid are cut through with firm movement of the saw. When this technic has been carried out on both sides, a blunt-end knife is used to remove the separated fragment of bone. This is done by passing the knife to the upper end of the excised bone, then completely freeing the section of any remaining attachments by drawing the knife downward to the tip of the nose. This separates the fragment of bone completely, so that it can be extracted with suitable forceps.

Irregularities which may be present in the nasal bone following operation are smoothed off with a rasp, and an angulated knife is used to trim off the nasal cartilage.[1–4]

To complete the cosmetic effect following removal of the hump, the nasal arch is narrowed by further bony operation. Details of this later procedure are unnecessary to the understanding of the question under consideration.

From the foregoing, it is at once clearly evident that the skin, in the undermining process, must suffer considerable injury to its deeper parts and to the subcutaneous

* From the services of Dr. George M. Coates, Graduate Hospital, University of Pennsylvania, and Dr. David N. Husik, Mount Sinai Hospital, Philadelphia, Pa.

tissues, particularly to its blood, lymph and nerve supply.

The skin itself has very definite lines of tension everywhere throughout the body surface, which are known as Langer's lines.[5] In the area of the nose, these lines run from the mid-dorsum downward and medial ward on either side, to the corners of the mouth, in a sweeping curve. Their path represents very closely the area where the skin is undermined in the operation outlined, and where the later restricted mobility occurs. It has been demonstrated[6] that injury to the tissues associated with these lines may result in disturbance of the normal skin tension.

If the anatomy of the skin is closely examined, it is seen that there are two chief layers; (1) epidermis (cuticle); (2) dermis (corium). The epidermis is non-vascular, its nutrition being derived from the plasma of the dermal vessels. The dermis is the foundation layer of the skin.

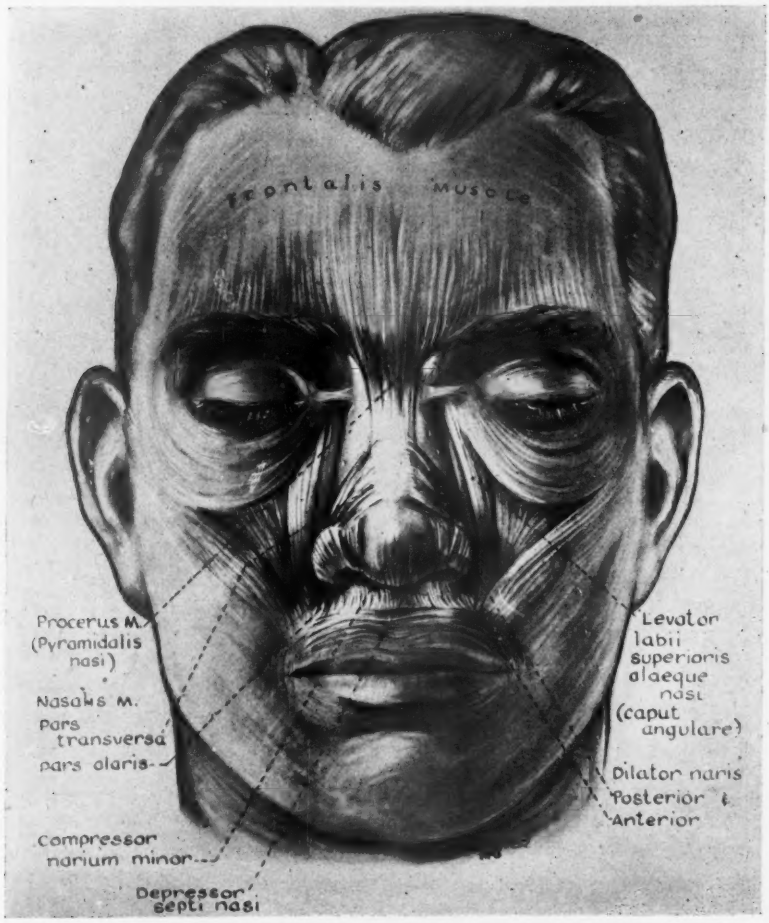


Fig. 1. Full face view showing facial muscles and intrinsic muscles of the nose.

The outer layer of the dermis is composed largely of white fibrous and yellow elastic tissue. It is somewhat vascular and also contains a number of nerve endings. The middle or reticular layer is closely connected with the subcutaneous tissue. This middle layer is made up of loosely-meshed, white and yellow elastic fibrils. It is of particular significance in the condition reported here, that these elastic fibrils run parallel with Langer's lines, which as already noted, are associated with normal skin tension.

The subcutaneous or inner layer of the true skin, or corium, is a loose network of connective tissue and contains the larger blood vessels, lymphatics and nerves of

the skin, as well as the deeper hair follicles, sweat and sebaceous glands.

The blood vessels in this deepest skin

Fig. 2. Profile showing intrinsic muscles of the nose.

layer anastomose with each other freely to form a network, from which branches pass upward to form a second vascular network at the junction of the outer and middle layer of the corium. From this level, numerous vessels run to the superficial layer as terminal arteries. Here they turn at right angles and lie parallel to the skin surface.[2]

In their work on skin-grafting in burns, Brown and McDowell[7] report that epithelium is the only part of the skin that regenerates. The important pad of the derma does not regenerate to any extent, nor do any of the structures in it, such as elastic tissue, sebaceous or sweat glands. It is obvious that there is no destruction of the skin elements in an undermining operation, but through disturbance of vascular and nervous function a temporary change, involving all the dermal elements, similar in nature, though not similar in degree, might follow the operation of undermining of the skin. This would involve the elastic tissues, which, as has appeared, are represented on the skin surface by Langer's lines, the representatives there of the direction of skin tension.

The subcutaneous layer receives the greatest injury when the skin is undermined. This undermining process necessarily disturbs the blood vascular and lymphatic channels which pass from the underlying muscular layer to the focal area of skin involved in operation. The result of this disturbance is the creation of a circumscribed lessening of the sources of nutrition and a general lowering of metabolism of the skin concerned. In this way, an area of artificial, circumscribed myxedema is formed. Such a condition has been described entirely apart from operative procedure.[8,9]

Myxedema is most frequently seen in conditions in which there is reduced thyroid activity, but it may occur in other disturbances of normal metabolism. It is occasionally seen in pellagra, which is essentially a disease of disturbed nutrition.

The myxedematous process is a response of the skin to a lowered nutritional level. Chemically and histologically, an abnormal production of mucin by the epithelial cells is found and particularly by the connective tissue in the subcutaneous skin layer. The connective tissue is increased and infiltrated with mucin. There is an accompanying reduction of oxygen consumption and of nitrogen metabolism in the affected tissues.[10,11,12]

A study of the capillaries in myxedematous patients has been reported by Zondek and his associates.[13] On examination of the nailfold by suitable means, they found a reduction in the number of capillaries with a notable narrowing of the lumen in those present. In some instances, only a fine line, which was barely visible, represented the capillaries. No flow of blood could be distinguished, and no arteriovenous anatomoses could be seen.

Using the pressure plethysmograph, the rate of filtration through the capillary walls in myxedema has been measured by White and Jones.[14] They conclude that the slow filtration rate in myxedema is partly due to increased tissue resistance caused by the infiltration with viscid

myxedema fluid. This observation had already been made by Landis and Gibbon.[15] The extremely low rates in the cases of White and Jones became much higher when the metabolic rate had been restored to normal.

Altogether, these observations indicate that a disturbed nutrition (metabolism) from any cause may result in the production of mucin by the connective tissues of the skin, or by the epidermal cells. The infiltration of mucin (myxedema) characteristically causes a waxy consistency of the skin, with loss of elastic tone. It has already been noted that mucin in myxedema is present in the connective tissues of the deeper skin layers, and that these elastic tissues run parallel with Langer's lines, which represent planes of tension on the skin surface.

These findings in myxedema due to general systemic disturbance may well be applied in the condition under consideration. Clearly, it is hardly possible to make a direct study of the tissues in this condition, as biopsy is particularly contraindicated, and unnecessary, since the improved technic which is presented below affords a means of avoiding the undesirable result.

In considering a limitation of mobility in facial expression following nasoplastic operation, not only injury to skin takes place, but disturbance of underlying muscles must also be considered as a factor, although injury to muscles alone would not cause the waxy fixity of facial expression, which has been encountered following the customary operative technic.

The muscles of the nose are all derived phylogenetically from a single muscle, the primitive platysma. In some human races, this muscle is still sometimes present, extending over the face. In all vertebrates below the mammals, the superficial facial musculature is restricted to the region of the neck. In mammalia, this musculature has spread over the head and on to the face, where it has made extensive connections with the freely movable skin. Since the matrix muscle of the neck was innervated by the facial nerve, all of the individual muscles evolved from it, including

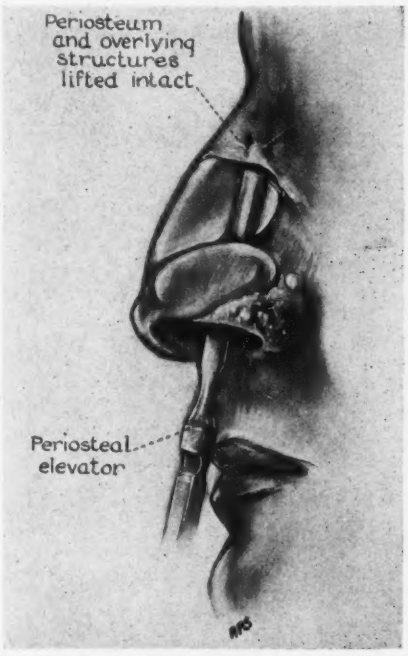


Fig. 3. Profile illustrating use of periosteal elevator, to avoid undermining the skin over the nose.

the nasal muscles, are innervated by facialis branches.[16]

The procerus muscle is continuous above with the medial portion of the frontalis, and actually belongs to the infraorbital group. This fact is based both on morphology and experiment. The fusion with the frontalis is a secondary connection. In "gibbons," the procerus muscle extends downward over the entire back of the nose.[16]

Ontogenetically, the development of the facial muscles in man is briefly a recapitulation of the main developmental stages of mammalian phylogeny.

The muscles of the nose vary between wide limits in the degree of their development, and one or more may be entirely absent. There is also a wide variation in their description by different authorities. However, if one bears in mind that all of these small muscles have arisen by special functional development from a single

parent muscle, the platysma, the many variations are clearly understandable.

The muscles of the nose[3,17,18] most constantly present are (Fig. 1):

1. Procerus (*pyramidalis nasi*) is a small pyramidal slip arising by tendinous fibers from the fascia covering the lower part of the nasal bone and upper part of the lateral nasal cartilage. It is inserted into the skin over the lower part of the forehead, at the root of the nose, between the eyebrows, where it interdigitates with fibers of the frontalis. It is in relation by its upper surface with the skin, and by its undersurface with the frontal and nasal bones. Its action exerts a slight drawing down of the inner angles of the eyebrows.

2. Nasalis (*compressor naris*) is in two parts: (1) The *pars transversa* is a triangular muscle extending from the bridge of the nose, where it is continuous by an aponeurosis with the muscle of the opposite side, and with the aponeurosis of the procerus. It is adherent to the skin and is only slightly attached to the underlying cartilage. Its fiber bundles converge toward the back of the wing, where they are attached to the skin along the line of the nasolabial sulcus. It is inserted beneath the nasal process of the quadratus labii superioris (*levator labii superioris alaeque nasi*) with which its fibers interdigitate. An attachment of origin is also sometimes described as occurring in the lower part of the canine fossa of the maxilla. (2) The pars alaris (*depressor alae nasi*) is a small quadrangular muscle, which is between the lower part of the nasal opening and the alveolar process of the maxilla. It is covered by mucous membrane of the oral cavity, by the orbicularis oris muscle, and by the quadrator (levator) labii superioris. It is fused laterally with the pars transversa (*compressor naris*). This muscle arises from the alveolar ridge of the lateral incisor and the canine teeth. Its fibers extend vertically to the skin of the dorsal margin of the nostril, from the dorsal portion of the cartilage of the wing to the septum. Its action aids in down the nasal alae.

3. The *caput angularis* of the *quadratus labii superioris* (*levator labii superioris alaeque nasi*) is not an intrinsic, but an accessory muscle of the nose. It is a thin muscle which extends beside the nose from the inner margin of the orbit downward in two divisions, one of which joins the ala and the other is inserted into the upper lip. Its action is to raise both the ala and the lip, as well as to aid in dilating the nostril and in deepening the nasolabial fold.

4. The *dilator naris posterior* is a thin, triangular muscle which lies on the side of the nasal wing, partly beneath the *quadriceps labii superioris*. Its place of origin is in the skin of the nasolabial fold, and from the lesser nasal cartilage. It is attached to the inferior border of the nostril.

5. The *dilator naris anterior* is a very small, thin muscle which passes from the lower margin of the cartilage at the front of the wing of the nose to the skin near the margin of the nostril. It lies in front of the posterior dilator.

6. The *compressor narium minor* is a small muscle attached to the alar cartilage and inserted into the skin at the nasal tip.

7. The *depressor septi* arises from the incisive fossa of the maxilla and its fibers are inserted into the septum and the posterior part of the ala.

The names of the greater number of these muscles indicate their action.

Occasionally a small longitudinal muscular strip has been found, which runs from the frontal process to the body of the maxilla, near the lateral margin of the nostril. This unusual muscle is called the *anomalous*.

The vascular supply to the alae and to the septum are the alar and septal branches of the external maxillary vessels. The dorsum and the sides of the nose are supplied by the dorsal basal branch of the ophthalmic and the infraorbital branch of the internal maxillary.

Together with the development of the facial musculature, there is a differentiation also in the nerves which supply it. These consist of the complex terminal branches of the facial nerve.

The question of facial expression has received considerable scientific attention, particularly during the latter half of the last century, when detailed observations were made by such investigators as Darwin (1897), Lavater (1832), Duchenne (1863), Bell (1877), Henle (1858), and others. These studies ignored the factor of skin function in the consideration of facial expression due to emotional stimulus, and were confined to the muscles of the face, in greater part. Darwin[19] limited his record of nasal muscles in emotional expression chiefly to the pyramidalis (procerus) as an adjunct to the eye muscles concerned in weeping. Jabet[20] expressed the opinion that "The nose is an important index to character; mind forms the nose—not nose, the mind." If this were literally true, there would be scant need for plastic surgery.

The interest of Duchenne,[21] whose illustrations are familiar to medical literature, centered about his theory that it should be possible to investigate, by the study of the muscular action, the laws which rule the expression of the human face. Accordingly, he sought by means of the electric current to "make facial muscles speak the language of the passions and feelings." His work gives little attention to the nasal muscles. He characterized the combined levator alae nasi and the levator labialis superior as the "muscle du pleurer a chaudes larmes." The "transverse muscle" of the nose is assigned to the expression of shiftiness and lasciviousness, and the dilator naris is considered as the complementary muscle of such violent passions as anger and rage.

It is particularly noteworthy in relation to the subject of this paper, that when Duchenne showed his colleagues the photographs of his subjects illustrating the contraction of different facial muscle groups in response to electrical stimulation, though they are the muscles of facial expression, it was not always possible to identify the pictures as typifying any given emotion.

This suggests the observation which can frequently be made in persons with facial palsy, that although voluntary movement may be impossible, emotional stimulation (to cause laughing or weeping) may bring out a considerable degree of muscular action, with the corresponding facial expression, which is not voluntary, but reactive. Many photographs which appear in the public prints, present facial expression due to voluntary muscle action, as in a purported smile, which is produced only by drawing back the corners of the mouth, but does not include the complex facial muscle action which follows true emotional stimulation. Duchenne concludes his description with the statement, that in repose the muscles still possess a force which "never sleeps" and that this force is tonicity.

The question of tonicity has been investigated and discussed at length. Following the introduction by Hunter, in 1924, of a theory of "plastic tone" (postural contraction), which considered that the cause of rigidity of striated muscle in spastic paralysis is due to the influence of the sympathetic nervous system, and various somewhat related ideas presented by others, numerous experiments have been done on ramisection. These experiments demonstrated that the innervation of the autonomic system is limited to the control of the vascular system, and that it does not otherwise affect muscle.[22–27]

Because of the importance of humoral influences, it is of interest to include the suggestion of Hinsey and Cutting (1933), that sensitized skeletal muscle may be caused to contract by elaborated sympathetic substances. The action of acetylcholine has been considered as an active factor in this relation.

Cobb and Wolff present the opinion that sympathetic nerves do not end in striated muscle, but that stimulation of

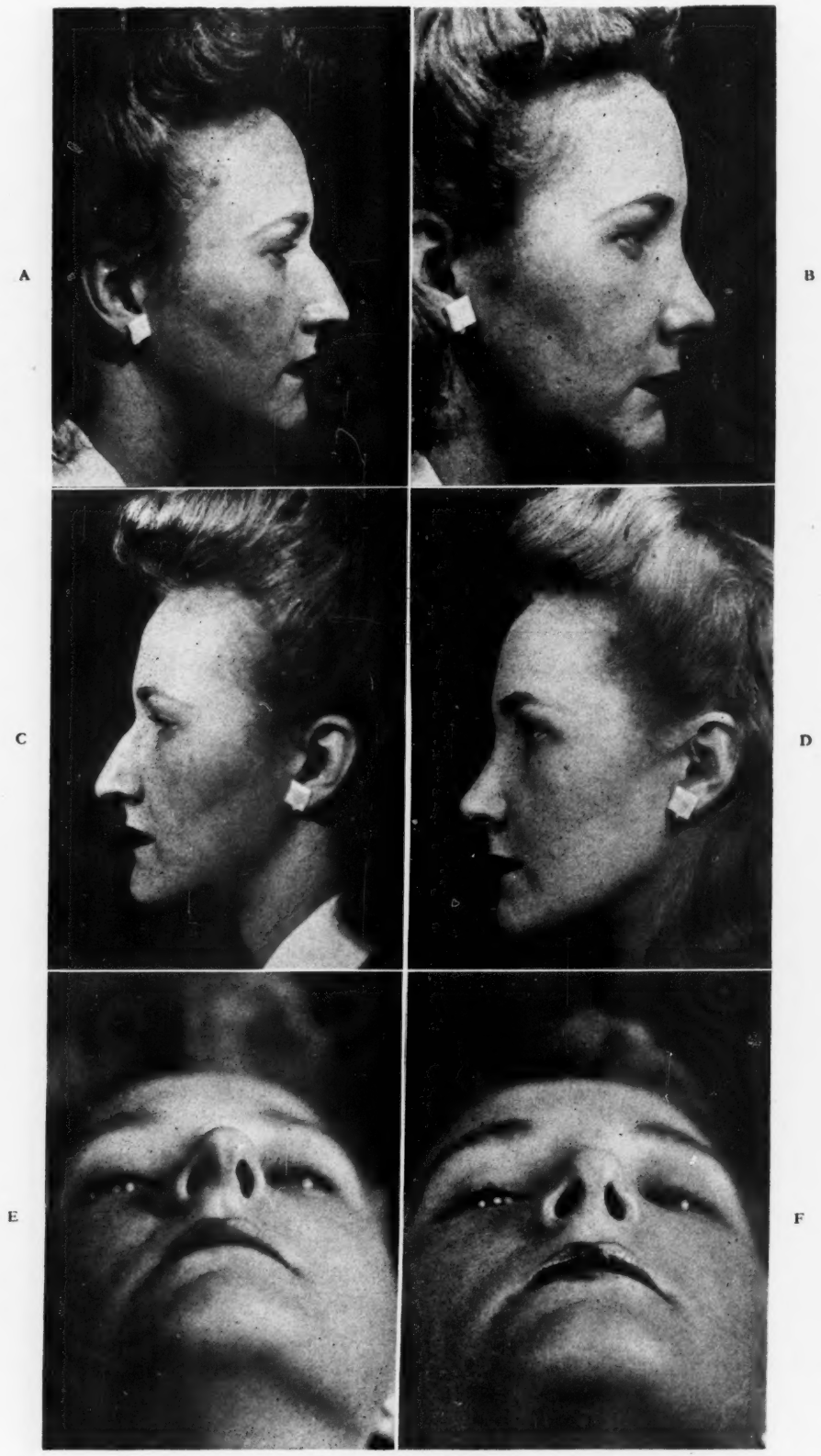


FIG. 4. Hump nose and irregular (unequal) nostils; A, C and E, before correction; B, D and F, after correction.

FIG. 5. Hump nose with deflected tip; A, C and E, before correction; B, D and F, after correction.

these nerves controlling the blood vessels of a muscle may alter the tissue fluids and blood in such a manner that change in muscular contractility is brought about. This viewpoint is held also by Grinker. It may be only another way of expressing the same idea as that of Hinsey and Cutting.

In view of these findings, since emotional expression results from autonomic (sympathetic) stimulation, injury to vascular and nerve supplies of the muscles and skin about the nose would alter the power both of voluntary and involuntary movement.

It is Wechsler's opinion that the loss of "effective emotional expression" may be due in part to cutting off the thalamic stimuli. This result would follow if the nerve terminals in the skin and muscles were destroyed or severely injured.

Although Nash[28] states that the function of the sympathetic nerve supply to skeletal muscle is not known, he adds that it can be detected only when muscles are at rest, since it is obscured by any voluntary influence on the muscle. He considers it probable that the sympathetic nerves affect all of the vital processes of muscle cells, partly by direct action upon them and partly by vasomotor influences upon the caliber and the permeability of the capillaries.

To give point to the question which concerns this paper, the following brief case histories are illustrative:

## CASE REPORTS

Case I. J. W., male, age twenty-seven, of Irish nationality, had a markedly aquiline nose. The customary operation of undermining the skin was used to reduce the nasal prominence. After an interval of about two weeks following the operation, there appeared a waxy immobility of the tissues in the field of operation. The cosmetic result was otherwise excellent, but after two months the focal facial immobility still persisted in some degree. The patient is conscious of a feeling of stiffness in the tissues, especially when laughing. He is also unable to wrinkle his nose voluntarily.

Case II. R. S., male, age thirty-eight, an actor, had a deflected nose. There was not only disfigurement, but also difficulty in breathing. A corrective operation was done, employing the skin-undermining technic. A perfect cosmetic effect resulted, with relief of breathing difficulty. Two weeks after the operation, a condition of limited mobility developed in the facial tissues. This persisted for nine months, but has gradually improved as the result of intensive exercise of the involved parts. This case is one of particular significance, since the patient's profession required the use of a high degree of facial expression.

That facial posture rests upon the integrity of the tissues which are altered in the process of undermining the skin, is supported by the results of the author's modified method of operation, which avoids any of the undesirable complications of reduced mobility of facial expression.

## AUTHOR'S MODIFIED OPERATION

The method which is employed in operating to avoid the temporary involvement of facial expression is the same as that practiced routinely, up to the point when undermining of the skin is usually begun. Here a straight Joseph's knife is slowly pushed upward through the original incision between the upper lateral cartilage and the skin, until the nasal bones are reached. Then an incision is made in the periosteum at the extreme lower margin of the nasal bone. This incision is accomplished with a McKenty periosteal lever. Very particular care should be exercised here in order to avoid tearing or fraying the periosteal tissue, since periosteal injury may stimulate the hyperplasia of osteophytes (osteoblasts) with resulting osteogenesis. This action can cause serious nasal deformity due to bony overgrowth.

The operation is then continued, using Joseph's periosteal elevator, which is similar to McKenty's, but is somewhat heavier. Through the primary periosteal incision, this tissue is elevated along the bony nasal hump, which is to be removed, up to the nasofrontal angle (glabella). With a careful side-to-side movement of the instrument, as it is advanced, the periosteum is peeled

away from the underlying nasal bones, as old wall paper is separated from a wall. The remainder of the procedure follows the usual method.

In this technic, care is taken to follow the course of Langer's lines, which have already been given emphasis in considering the skin.

Since the muscles are not attached to the nasal bones, but lie over the periosteum and under the skin, the bone fragment can be separated and removed without in any way disturbing either the muscles or the skin.

Following removal of the hump, by elevation of the periosteum only, there has been no appearance of the waxy inelasticity, which has occurred after the use of the method in which the skin is undermined.

It should be added, that special conditions may exist, which indicate a preference for the technic in which the skin is undermined. As elsewhere, this is a question of choice depending upon judgment and experience.

## SUMMARY

1. A waxy immobility of the tissues about the nose has often occurred after the operation for removal of nasal hump, in which the method of undermining the skin was used.

2. It has been demonstrated that the condition of focal lack of facial motility following removal of nasal hump can be avoided by doing the entire operation by means of periosteal elevation.

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# FAILURE OF CURE OF PELVIC INFECTIONS FOLLOWING THE USE OF PENICILLIN*

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THE verb "cure" means the successful treatment of a disease, or to heal or restore to health or soundness.

There have been numerous reports recently regarding cure of gonococcal infections with penicillin. These reports have been mainly in cases of gonococcal urethritis in men, and the criteria of cure has been established by clinical and laboratory examination.[1] Even symptoms of salpingitis and pelvic peritonitis have been reported to abate within twenty-four to forty-eight hours following the use of penicillin.[2] Other reports of adnexal involvement in sulfa resistant gonococcal pelvic infection reveal about a 50 per cent rate of cure.[3] Criteria of cure of pelvic infections, mainly gonorrheal pelvic infection, cannot be based on serologic tests of gonorrhea, smears, cultures, and clinical data because the tests are not always dependable, and the clinical data are not always infallible. Therefore, the most dependable test of cure is repeated observation over a long period of time. This period of observation should extend to at least one year, during which time every examination, smear, and culture should be negative. So it is a fallacy to call a person well after three negative smears, and cultures, because of the numerous recurrences that have been reported in the literature and that happen in the practice of physicians.

The following pathogenic organisms, staphylococcus, clostridiae, hemolytic streptococcus, anaerobic streptococcus, and the pneumococcus, constitute the next most frequent organisms in the causation of pelvic infections in women. In addition, 5 per cent of all pelvic infections are due to the tubercle bacillus. Finally, very uncommonly, actinomycosis and bacillary infections as typhoid and the Salmonella groups have been found as the etiologic agents of pelvic infections.

Chronic pelvic inflammation of peritoneal and parametrial tissues leaves its mark on the pelvic organs and is manifested by (1) ovarian dysfunction; (2) pelvic pain due to uterine displacements, contraction of cicatrical tissue and dense posterior adhesions; (3) dysmenorrhea resulting from periadnextis and chronic parametritis with associated varicose pelvic veins.

Fifteen cases of pelvic inflammation in the acute and subacute stage have been studied. They consist of young white females varying in age between twenty to twenty-five, and five are married but nulliparous. All of the patients, according to the history and thorough physical examinations, including pelvic examination that had been performed within one year of the onset of the present condition, were experiencing the first attack of their disease. Urethral and cervical smears and cultures were reported negative at the first examination, and three subsequent smears and cultures were negative at intervals up to four months from the onset of the disease. Treatment consisted of the following in order: Full course of sulfadiazine followed by penicillin. The dose of penicillin varied from 500,000 to 600,000 Oxford units. If no relief of signs or symptoms of pelvic disease followed, two additional courses of penicillin in the same dosage were used. In addition, bed rest,

* The opinions or assertions contained herein are the private ones of the writer and are not to be construed as official or reflecting the views of the Navy Department or the Naval Service at large.

high caloric diet and hematinics, if indicated, were used.

These cases despite the above regime have not responded to the above treatment because symptoms and signs of chronic pelvic inflammation are still present, viz., chronic lower abdominal pain and induration of the parametrial tissues, scarring in the posterior cul-de-sac and inflammatory masses in the adnexal areas.

Gonorrheal infection, staphylococcus, hemolytic streptococcus, or anaerobic streptococcic infections are probably the basis for these pelvic inflammations. Tuberculous infection may be eliminated by exclusion since all cases had negative Mantoux tests and general physical examinations and pertinent *x*-ray examinations exhibited no evidence of a primary tuberculous process. The typhoid and Salmonella infections may be excluded by stool examination failing to exhibit the causative organism.

According to the co-operative study of Keefer et al.,[4] penicillin is of value in all cases of sulfa resistant gonorrhea and all gonorrheal infections complicated by arthritis, endocarditis, ophthalmia, peritonitis, and epididymitis. Also, its exhibition has been of value in diseases caused by the following pathogenic organisms: staphylococcus, clostridiae, hemolytic streptococcus, anaerobic streptococcus and the pneumococcus.

Despite the fact that penicillin has been called almost a specific for the above mentioned pathogenic organisms, its exhibition in these cases has not been attended by complete clinical success which should be manifested by restitution of the involved organs to the normal state. The probable causes of the failure of penicillin may be due to the presence of bacteria which are resistant to penicillin or actually destroy it, or to a morbid anatomical condition that prevents the solution from reaching all parts of the lesion or from persisting there, and finally an antecedent fibrosis mechanically preventing healing.

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# PROSTHETIC RESTORATIONS AFTER AMPUTATIONS ABOUT THE HAND*

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WAR injuries and industrial trauma have brought amputations and their prosthetic correction again to the attention of the industrial, orthopedic, and plastic surgeons. The usual definitive treatment has been: (1) If the entire hand was lost, an artificial hand was supplied. This hand was one of two types: (a) a hand with no movement and (b) an articulated hand. In the artificial limb trade an articulated hand means an artificial hand engineered with the thumb and fingers provided with movement. Whether the patient is supplied with a simple artificial hand or an articulated one, the substitute hand is covered with a leather glove for esthetic reasons. Sometimes a "working hook" is supplied instead of the artificial hand. Some of these are quite ingenious and useful, but they have a very limited appeal to the patient. (2) If only part of the hand was lost, or if fingers were lost, generally no esthetic restoration was offered to the patient.

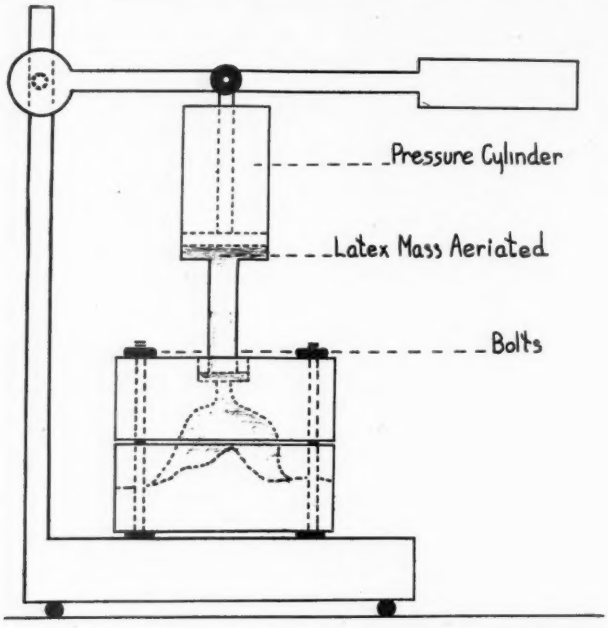


FIG. 1. A pressure gun for extruding frothed or foamed late mixtures into prosthesis mold. Frothed compounds are so light in weight that gravity is of little help in pouring the cast.

The technology of plastic materials, including rubber, has advanced so rapidly in the last few years that now it is possible to make life-like restorations for loss of the fingers or hand. It is also possible to cover a mechanical hand with a life-like surface, simulating the texture and skin tracery, even the fingernails, of the remaining hand.

For such a prosthesis as a finger, or a similar part, which is subject to wear and

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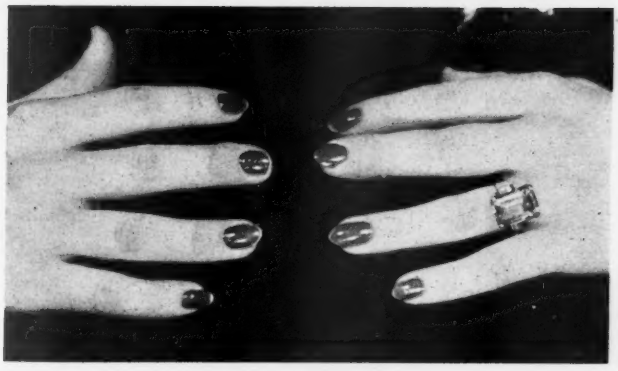
tear, this can often be made of poured molded liquid latex in the form of a hollow shell, especially if only a portion of the mineral oil, or commercial separating compound. It is then assembled and poured, using alpha gypsum to make a hard plas-

A



B

Fig. 2. A, prosthesis for loss of finger tip. Prostheses of this type can be made to fit snugly and securely without adhesives. The fingernail is removeable. B, prosthesis for fingertip; patient wearing prosthesis.

member is missing. For a more extensive prosthesis, it is sometimes advisable to make the prosthesis in such a way that the exterior is made of molded liquid latex in the form of a hollow shell, and the interior is filled with frothed or sponged latex.

A prosthesis of molded latex with frothed rubber filling has these advantages: (1) It is elastic, yet firm; (2) it is not so heavy as a solid rubber prosthesis; (3) it has a lifelike feel, and (4) it wears well.

*Technic.* For a prosthesis such as a restoration for a missing finger or missing portion of the hand, an enveloping two-piece negative mold is made of No. 1 molding plaster in the usual way. The impression is first coated with petrolatum, ter, positive cast of the deformed hand. Upon the hard plaster reproduction of the deformed organ, the restoration is sculptured in clay. It is wise to sculpture the finger so that it is slightly flexed in the normal position in which the hand is at physiological rest. It is not necessary for the patient to pose for this sculpture.

Instead, as a model, a reproduction of the patient's opposite hand is made, in order to have a complete picture of the corresponding finger of the perfect hand in relation to the hand as a whole. From this a negative mold is made as for the deformed hand and is filled with molding plaster. Later the negative is discarded,

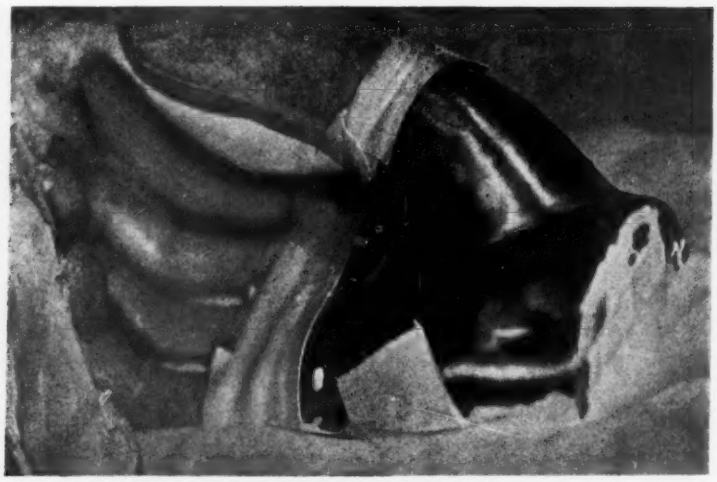
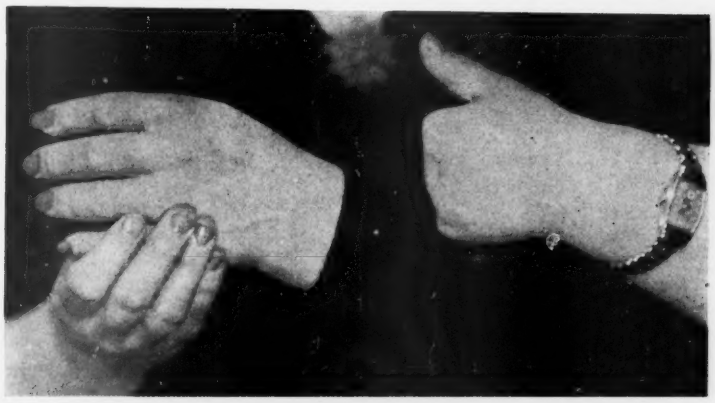


FIG. 3. Artificial hand embedded in plaster. From this negative mold a positive cast will be made and upon it will be designed a life-like cover to replace the leather glove which is usually supplied with an artificial hand.

FIG. 4. Almost total loss of hand. Sculpture completed (Fig. 5 A); note fingernails in position. A clay wall has been built around the sculpture preparatory to pouring a three-piece plaster mold around the sculpture.

leaving a positive reproduction of the "good" hand, or finger, to use as a model.

But the model is not copied exactly. In sculpturing a restoration for a missing finger, for example, the restoration in clay must be over-sized for three reasons: (1) To allow for the shrinkage of the rubber; (2) to allow a portion of it to slip sleeve-like over the amputated stump, and (3) to prevent it from appearing "tight," "meagre," or "skimpy."



A

B

Fig. 5. A, loss of almost the entire hand. Artificial limb makers have very little to offer to restore such a deformity. B, same patient with prosthesis. Note wrist watch (bracelet can be used) covers the edge of the prosthesis.

*Sculpture for the Fingernail.* A major part of the problem at this point is solved in that artificial fingernails are commercially available. A suitable fingernail is selected and trimmed to simulate the remaining nails. During the sculpture of the nail-bed, the false nail is put into place and the nail-fold (or groove in the cutis in which lie the margins and proximal edge of the nail) is sculptured over its edges. When the restoration is finished, the artificial nail will fit into this nail-fold, or trench.

The artificial nail remains *in situ* during the pouring of the prosthesis. The first portion of the mold is the positive plaster cast of the reproduction of the deformity (which is now bearing the clay restoration). The two other sections of the mold should each cover portions of the restoration and parts of the positive cast. When thoroughly hardened, the three-piece mold is separated and the clay washed out. The tip of the nail will be found to be imbedded in its proper position in the plaster mold. It is now ready for the pouring of the mold.

In order to obtain maximum flexibility of a prosthesis, the rubber for the interior of the prosthesis may be developed to high flexibility by making it spongy. The latex may be thinned with its usual diluent.

In a prosthesis of this type, the rubber mix for the surface of the prosthesis must

have its coloring adjuncts added before pouring. The colored rubber mix is cast into the mold and permitted to vulcanize

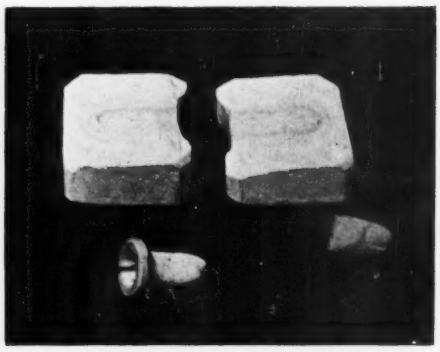


Fig. 6. Three-piece mold used to make prosthesis for end of finger.

for approximately one-half hour. The remaining liquid rubber is then poured off. This will leave a shell of rubber within the mold between one-sixteenth of an inch and one-eighth of an inch in thickness. If the shell is less than one-sixteenth of an inch in thickness, the liquid rubber may be again cast into the mold, and after fifteen minutes poured off again. This process may be repeated until the desired thickness of rubber shell is obtained.

Once the shell of the prosthesis is cast, it is ready for the interior to be filled with a core of frothed latex. A small quantity of latex is poured into a bowl, a commercial frothing agent is added, and it is whipped with a motor driven egg beater until its volume is increased five times. A gelling agent is added, and after a few more minutes of mixing to disperse the gelling agent, the aerated mix is ready to be used in filling the interior of the prosthesis. Once the mix is homogeneously aerated, it is advisable to pour the mold. With rubber of this consistency it is best to use a pressure molding technic. Manual pressure with a piston and cylinder defice is sufficient. (Fig. 1.)

The assembled mold for this technic had best be fastened firmly together with furniture maker's clamps or with long stove bolts as illustrated. A minute outlet should be provided to indicate to the technician when sufficient pressure has been exerted. This is evident when the extruded rubber makes its appearance at the outlet orifice, and shows that the rubber has been injected with sufficient force to insure the most delicate feather edge to the prosthesis. Once this pressure is obtained, the mold is heated at about 180°F. for an hour or two to finish the vulcanizing process.

The pores of the plaster are not necessarily utilized to aerate the rubber. The whipping process introduces enough air to hasten the coagulation of the rubber. The rubber mass is poured into a metal cylinder having a one-inch tube extension. The pressure cylinder containing the colored aerated mix is then placed into position over the flue of the mold, and manual pressure is applied to the piston forcing the liquid sponge rubber into every crevice of the mold. It is now ready for heat vulcanization, if this is desired. This may be accomplished in an oven, or by immersion into boiling water for an hour.

The parts of the mold are then separated and the prosthesis is removed. The artificial fingernail will not come out of the mold so easily as the prosthesis. The fingernail remains imbedded in its trench in the plaster mold. The seams, or flashing, upon the prosthesis is now cut away with manicure scissors and the lines corresponding to where the parts of the mold came together are further obliterated by grinding with a granite dental wheel. A small flashing will be found present along the line corresponding to the cuticle of the nail. This is also trimmed smooth with a small scissors. The nail may now be removed from the mold and inserted in its proper bed at the finger tip. It will fit neatly into the molded trench at the tip of the finger. It may be semipermanently glued in this position with a gum mastic adhesive, or with the following mucilage: celluloid 25 per cent, acetone 75 per cent. The prosthesis is then ready to wear.

Prosthetic fingers and hands may be fixed into place in several ways. A prosthesis involving the terminal phalanax alone,

can be slipped into place and will stay firmly without a mucilage. A prosthesis for the entire finger generally requires a water-proof adhesive.* A prosthesis for loss of all the fingers, or to restore most of the hand, should be so made as to reach to the wrist, and it requires no mucilage. The prosthesis is put on in much the same way as a rubber glove is slipped on. The edge of the prosthesis may be disguised with a wrist watch. (See illustration.)

The prosthesis may be washed in soap and water. A patient wearing a prosthesis is advised to remove it when retiring for the night.

For the female patients, when the prosthesis is for the fingers or the entire hand, two sets of artificial fingernails are generally supplied. This is to allow for breakage of the nails and to allow the patient to color the nails if she so desires.

After having made many fingers and hands for people who have suffered amputations, certain conclusions are unavoidable. The average intelligent patient, after having suffered the postoperative emotional shock of an amputation, is usually disturbed to discover that although his surgery was well done and individualized, restoration for his loss is difficult to obtain on an individual basis. He approaches the artificial limb maker to discover that generally the artificial limb is supplied in three sizes. If his loss is less than a total loss of the hand, the trade has nothing to offer him better than what would amount to a stuffed leather glove.

There is a definite place in plastic surgery for these victims of amputation to obtain a realistic cosmetic restoration for their deformities. For many years, plastic surgery has been more or less the stepchild of the practice of medicine. It has taken two wars for this branch of surgery to obtain a recognized, legitimate place. Likewise, it seems that at the present time plastic surgical prosthetics is the stepchild of plastic surgery itself.

For those doctors who are esthetes, plastic surgical prosthetics, although sometimes an exasperating kind of work, should be of interest. Doctors who are willing to do this time-consuming work, and have a chance to see their creations worn by the patient, will realize they are truly practicing the "art" of medicine.

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# TRANSVERSE INCISION FOR APPENDECTOMY

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THE ideal incision for appendectomy should give adequate exposure of the ileocecal region, divide fascia and muscle in line with component fibers, and produce minimal trauma to nerves traversing the area.

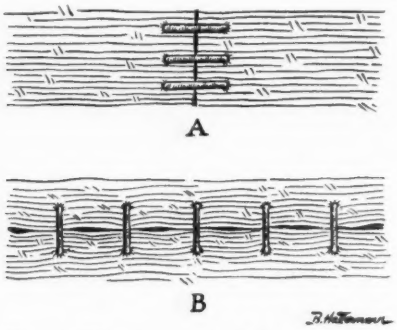



FIG. 1. Diagrammatic sketch showing suture in tissues. The tendency to separate fibers and pull out is greater in (A) where suture strain is in line with component fibers than in (B) where the pull is directed against the fibers.

McBurney's incision, difficult to enlarge when complications are encountered, and requiring separation of muscle fibers with consequent nerve avulsion, is probably the most frequently used approach for appendectomy. This incision was originally advocated for interval appendectomies only, where no difficulties were anticipated. Certainly it is not ideal for the removal of an appendix situated retrocecally, particularly if there has been arrest in the descent of the right colon, leaving the ileocecal junction in the lumbar region.

The right rectus incision is popular, and gives excellent exposure, particularly when freely made. It is easily enlarged. However, fibers of the rectus sheath, transversalis fascia and peritoneum are cut across, which weakens the closure. Any straining on the part of the patient spreads the wound, and sutures between fibers and in line with them are more likely to pull through than those placed transversely. (Fig. 1.) If the rectus muscle is retracted mesially, fibers of the tenth and eleventh intercostal nerves, making their entrance to the rectus muscle from a lateral direction, are damaged by stretching. The same is true of nerves supplying the mesial half of the rectus muscle when it is split for a transrectus approach. If the rectus muscle is retracted laterally, in order to spare these nerves, the trauma incident stretching is eliminated, but the incision overlies the abdomen at a point considerably mesial to the appendiceal region. This requires traction for delivery of the cecum.

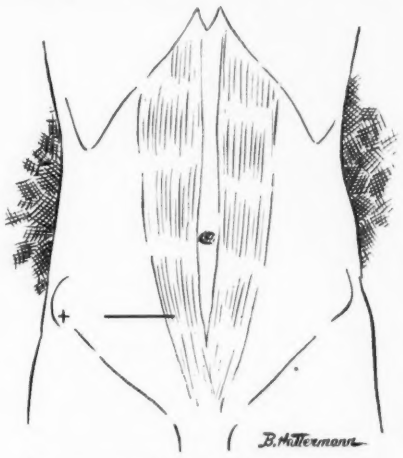


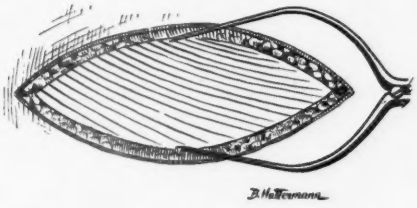
FIG. 2. Landmarks for the transverse incision. Approximately the outer half or one-third of the rectus sheath is exposed, and the incision is made laterally to within 2 or 3 cm. of the anterior superior iliac spine.

The midline incision is still farther removed from the ileocecal region, and provides less strength after repair than the rectus incision, producing all the disadvantages of dividing fascia transverse to its fibers, without the interposition of the rectus muscle.

The ideal approach to the celomic cavity for appendectomy is the transverse incision advocated by Rockey and Davis. Originally designed to pass transversely through McBurney's point, it has been modified to some extent by Alton Ochsner, who makes a longer incision than the 6 cm. advocated by those who first described it, and who locates it somewhat lower on the abdomen, viz., at the level of the right anterior superior iliac spine. Ochsner's incision is of sufficient length to assure adequate exposure in acute cases, and in interval appendectomies to facilitate examination of the terminal ileum for Meckel's diverticulum, as well as inspection of the internal genitalia in females.

This type of incision opens the abdomen directly over the ileocecal area, and frequently the appendix is visualized as soon as the peritoneum is incised. The rectus sheath and external oblique aponeurosis to a great extent, and the internal oblique muscle and fascia, transversalis fascia and peritoneum are divided in line with their component fibers. Any inclination of the patient to strain tends to approximate the wound edges. No large vessels are sacrificed, and the twelfth intercostal nerve fibers which traverse this field are easily located and avoided. If necessary, the incision may be readily enlarged by a vertical extension cephalad on the rectus sheath, creating a flap through which

Fig. 3.



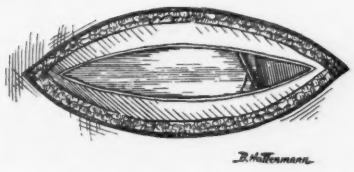
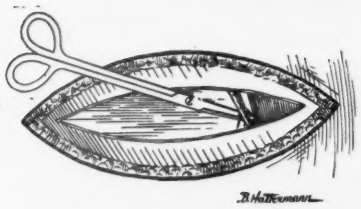


Fig. 4.

Fig. 5.



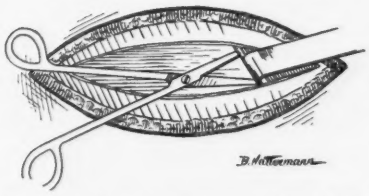


Fig. 6.

Fig. 3. The skin incision has been made, exposing the aponeurosis of the external oblique and rectus sheath. Note that as the rectus sheath is approached, fibers of the external oblique aponeurosis take a transverse course. Laterally, these fibers incline somewhat cephalad, and have a tendency to retract in that direction when cut. This must be borne in mind as the wound is closed, in order that this leaf may not be overlooked. The Gelpi perineal retractor is in place. Skin towels are omitted from the drawing.

Fig. 4. The rectus sheath has been incised in line with its fibers, exposing the muscle. Note that the component sheets of external and internal oblique aponeuroses tend to separate. As the incision is extended laterally, the twelfth intercostal nerve and its vessels are seen lying between the internal oblique and transversalis fascias. This level is caudad to the semilunar fold of Douglas. The size of the nerve has been exaggerated for clarity. In well developed subjects, muscle fibers of the internal oblique will be encountered in the lateral part of the incision. These run transversely and are readily separated.

Fig. 5. Curved Mayo scissors, point upward, are thrust and spread posterior to the twelfth intercostal nerve, its accompanying vessels, and the rectus muscle.

Fig. 6. As the spread scissors are lifted, a Parker retractor is inserted, and the nerve, vessels and rectus muscle are gently held in a mesial direction. The deep epigastric vessels will easily be seen if they come into the field, and can be avoided.

adequate exposure has been provided for cholecystectomy incidental to a mistaken diagnosis.

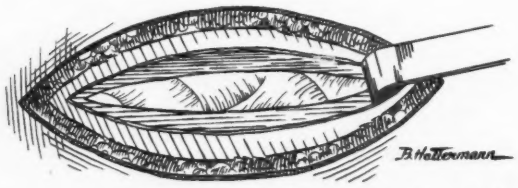


Fig. 7. Division of the peritoneum in line with its fibers, which are transverse, completes the incision. It is not unusual to find the appendix lying in the wound.

The skin incision is made transversely from a point approximately over the center of the right rectus muscle to within 2 cm. of the right anterior superior iliac spine. (Fig. 2.) It is not unusual to encounter less than four superficial vessels requiring ligation. Subcutaneous tissue is divided to provide a clear view of the anterior rectus sheath and external oblique aponeurosis. (Fig. 3.) A Gelpi self-retaining peroneal retractor will be found useful in keeping the skin edges apart.

The fascia is divided in line with the skin incision. As the rectus sheath is incised, the component external and internal oblique fascias will be seen to separate. (Fig. 4.) As the incision is carried laterally in well developed subjects, muscle fibers of the internal oblique will be encountered. These, however, run in line with the incision, and are easily separated. Bleeding will be minimized if the handle of the scalpel is used for this maneuver.

As the fascia at the lateral border of the rectus sheath is divided, care should be exercised to avoid injury to the twelfth intercostal nerve and its concomitant vessels, which run between the internal oblique and transversalis fascias. This is readily seen, and should be included in the Parker retractor used gently to hold rhe rectus muscle mesially. A pair of curved Mayo scissors thrust point upward and spread beneath the nerve and vessels will facilitate the introduction of the rectractor. (Figs. 5 and 6.) As the rectus muscle is lifted anteriorly and mesially, the inferior epigastric vessels are in full view.

This level is caudad to the semilunar fold of Douglas; hence only transversalis fascia and peritoneum remain to be incised. These structures are picked up and divided in line with the other incisions, viz., in a transverse manner. (Fig. 7.) Enlargement of the peritoneal incision in either direction may be accomplished by tissue scissors under direct vision.

In closing, the peritoneum and transversalis fascia are usually taken as one layer. When the rectus muscle is allowed to fall back in place, it will be seen that much of the incision is covered. DeBakey has made the entire peritoneal opening posterior to the rectus muscle.

It will be found convenient when placing interrupted sutures, to have these cut to fourteen-inch lengths previously. The nurse should have several loaded needle-holders available. As the sutures are inserted, the assistant gathers the ends, holding them in a sheaf. After the necessary number have been put in place, the assistant passes them back to the operator for tying, one at a time, making traction on the remainder. This approximates the wound edges, and greatly facilitates closure. When tying has been completed, the row of sutures is held up and cut directly on the knots, leaving a minimum of thread in the wound.

The anterior rectus sheath is closed in one layer, care being taken that both the external oblique and internal oblique components are included. The cephalad leaf of external oblique aponeurosis has a tendency to retract and may be overlooked if care is not taken. Suturing as one layer continues until the muscle fibers of the internal oblique are encountered. If there has been a pronounced separation of fibers, a suture is inserted and tied loosely. The approximation of the fibers of the external oblique fascia is then continued laterally. At this point the Gelpi retractor and skin towels are removed.

Superficial fascia is easily visualized by everting the skin edges, and is closed with interrupted sutures.

Approximation of the skin completes the procedure. The cosmetic effect, of minor importance from a surgical standpoint, sometimes warrants consideration, particularly in young women. The transverse incision does not directly cross the skin lines of Langer in this region, and a thin scar results unless complications intervene. The belt line is on a level with the iliac crests, and consequently is completely cephalad to the scar, obviating the possibility of friction or pressure.

If drainage of the abdominal wall is indicated, rubber dam tissue may be introduced laterally through the skin incision, and directed in a mesial course to the peritoneum beneath the rectus muscle. This drains the entire incision.

## CONCLUSION

The little used transverse incision for appendectomy may be made rapidly with little damage to fascia, muscle, nerves or vessels. It produces excellent exposure, and is easily enlarged when necessary. It is readily closed even with the patient straining under a poor anesthetic. Fascial approximation with sutures transverse to component fibers provide a firm repair. The cosmetic effect is gratifying.

An unnecessary appendectomy should not be done during an abdominal or pelvic operation which probably will be followed by some oozing of blood into the peritoneal cavity. A sump drain is routinely advisable if there is a possibility of postoperative oozing both to indicate the presence and amount of oozing and to keep the cavity free from blood and exudate.

From "Principles and Practice of Surgery" by W. Wayne Babcock (Lea & Febiger).

# CLINICAL USE OF A RED CELL AMINO ACID MIXTURE AS A SUBSTITUTE FOR WHOLE BLOOD TRANSFUSIONS*

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IN a British medical symposium on blood derivatives for transfusion, the increasing popularity of red cell suspensions as a therapeutic agent was discussed by military and civilian physicians. Vaughan,[1] Whitby[2] and others claimed that the transfused cells obtained from fresh stored blood "lasted well" in the circulation and that the concentration of hemoglobin was raised as much as 20 per cent from the injection of the cells from one pint of blood. Besides the above advantages, Davidson and Stewart[3] pointed out the economic gain in utilizing the cells available as a by-product of the process of plasma preparation from whole blood. Moreover, in this symposium all were in agreement as to the safety of the intravenous administration of red cells and its therapeutic value for the patient with anemia and sepsis.

In this country also there has been a trend to explore and extend the use of cellular transfusions. Alt[4] reported the case of a patient in refractory anemia who was maintained for one year by infusions of red cells from 25.5 liters of blood. Murray et al.[5] administered 116 infusions of red blood cells and reported only two pyrogenic reactions and no hemolytic manifestations. Evans[6] found that the injections of red cells was especially advantageous for anemic patients resistant to iron and liver therapy.

The search for plasma substitutes has become an important therapeutic endeavor because of the war emergency. Amino acid solutions from hydrolyzed casein have a proved value as a source of nitrogen for the maintenance and restoration of depleted tissue protein. In shock associated with acute hypoproteinemia the intravenous injection of amino acids has also been reported as beneficial.[7]

In the present investigation the intravenous administration of a mixture consisting of red blood cells, amino acid and isotonic glucose solution was tested. It was used in the supportive therapy, pre- and postoperative for patients ordinarily receiving transfusions of whole blood. The patients were usually in the anemic hypoproteinemic state, both of which conditions are often co-existant. In each case a red cell count, hemoglobin determination, hematocrit cell volume, plasma protein, icteric index and urobilinogen were determined at appropriate intervals.

Red blood cells were available in large quantities and for all types of blood as a side product of the preparation of plasma. The cell mass was kept in its original container (Baxter vaco-liter bottle) after removal of the plasma by suction in the prescribed sterile manner. The average age of the cells in most of the infusion mixtures (60 per cent) was about one to three days. In the rest, older blood (average age four to ten days) was used. Enough

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plasma remained in the bottle to make the material sufficiently fluid to flow readily.

The infusion of cells and solution was given by the two bottle drip method consisting of the container with the red cells and a second bottle a Kelly flask with amino acid glucose mixture. The cellular fluid passed through a mesh filter which retained the buffy fibrinous material. It then passed through a Murphy drip cannula and mixed with the amino acid glucose solution which was also regulated separately by the drip method and a clamp screw. The tubing from each fluid system was connected by a Y tube to a central delivery tube. The entire administrative procedure was simple, involved no extra manipulation and the possibility of bacterial contamination was minimal.

The infusion of the above described mixture and the quantity of its component parts depended on the state of anemia and hypoproteinemia of the patient. The amino acid glucose portion of the mixture served as a supplement to the patient's oral protein intake or was given as the sole nutritive medium to those who were dependent entirely upon intravenous alimentation. For the latter the mixture provided amino acids as a substitute for protein nitrogen and included enough glucose solution to supply at least 1,500 calories. A 15 per cent amino acid casein digest solution with a total nitrogen content of 2 per cent was used. The amount of nitrogen (amino acid) given to each patient varied but was equivalent to 20 to 100 Gm. of protein depending on individual requirements and the discretion of the surgeon.[8] The usual cross agglutination tests prerequisite for blood transfusion were also made. The cellular portion of the infusion comprised the cell mass from 500 c.c. donations of blood. In some cases, two or even three bottles of such cells were given successively.

The mixture was given intravenously a total of 164 times to thirty-one patients, eighteen of whom had malignancies of the gastrointestinal tract. In ten patients it served as the sole preoperative infusion medium. Each of seven patients received nine such infusions. It was given also to four patients in shock during and after the stress of the emergency.

Infusion reactions were similar to those following transfusions of whole blood. (Table I.) The occurrence of chills or fever was traced, appeared to be pyrogenic in nature and was attributable to the toxicity of the anticoagulant sodium citrate. The latter was determined by the methods recommended by Co Tui.[9] Jaundice when it appeared was transitory and was associated with a moderate increase in the icteric index. An elevation of urobilinogen was detected in 12 per cent of the urine samples. Hemoglobinuria occurred on two occasions but disappeared after twenty-four hours.

Table I
INFUSION REACTIONS

| Kind of Reaction | Incidence, Per Cent |
|---|---|
| Fever | 3.8 |
| Chills | 2.5 |
| Jaundice | 7.0 |
| Hemoglobinuria | 0.7 |

Table II
SHOWS CHANGES IN THE BLOOD (AVERAGE VALUES) AFTER COMPLETION OF TREATMENT BY THIS METHOD

| Blood | Initial Value | Final Value |
|---|---|---|
| Erythrocytes | 2.8 Million | 4.3 Million |
| Hemoglobin | 47% | 81% |
| Hematocrit value | 30.1 v.% | 41.9 v.% |
| Plasma protein | 5.4 gms.% | 6.7 gms.% |

Improvement in the anemic hypoproteinemic state was obtained in the thirty-one patients. The average, the initial, and the final results are shown in Table II. After each of all but four infusions the red cell count in the recipient usually rose from 50,000 to 215,000 cells per cu. mm. The hematocrit cell volume paralleled the change in erythrocytes and indicated a more normal relationship between the cell and plasma volumes. The increase in hemoglobin averaged between 3 per cent

and 12 per cent after each infusion. The rise in the plasma protein level was variable and generally slow but averaged about 1.3 Gm. per cent. However, the final protein value in slightly more than half the cases failed to reach a concentration of 7 Gm. per cent. This was most apparent in those patients who were sustained solely by parenteral means.

## COMMENTS

The increase in the red blood cells and the hemoglobin concentration may be accounted for on the basis of stimulation of the red bone marrow and the acceleration in the synthesis of hemoglobin from newly formed globin and available iron. The possibility of the infusion of some free hemoglobin with the cells cannot be denied. Whether due to dehemoglobinization or hemolysis it did not seem to cause any severe reactions other than transitory jaundice and the two instances of hemoglobinuria. It must also be observed that the infusion of the cell mass from 500 cc. of blood in itself actually represented an addition to the patient's blood of about 75 Gm. of protein in the form of hemoglobin. However, the present studies confirmed the claim of Ross and Chapin[10] that the infusion of red cells regardless of their survival time in the blood was an excellent therapeutic agent superior to any hematopoietic drug.

The slow rise in the plasma protein level may have been due to the synthesis of hemoglobin and the replenishment of indispensible protein taking precedence over other forms of protein regeneration.[11] This slow rise may also be accounted for on the basis of infection or metabolic disease[12] which could have retarded the return of the plasma proteins to normal. Although the plasma protein level was not restored to normal in all cases, there were clinical indications of improvement such as gain in weight and satisfactory wound healing. Bassett and others[13] have had a similar clinical experience and concluded that the use of intravenous amino acids satisfied nitrogenous requirements and stimulated the formation of body protein.

The four patients in shock reacted well to the red cell amino acid mixture. This response may have been due primarily to the red cell and the increased oxygen-carrying capacity of the blood. However, Elman and Lischer[7] have observed that amino acid solutions injected into animals in hemorrhagic shock exerted a favorable effect on the survival time similar to that obtained with the use of plasma.

## SUMMARY

1. A mixture of blood cells, amino acids and isotonic glucose solution was found to be of general therapeutic value as a substitute for whole blood transfusions.

2. The cellular mass remaining after separation of the plasma from whole blood can be used advantageously.

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# BRIDGE OPERATION FOR DUPUYTREN'S CONTRACTURE*

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DUPUYTREN'S contracture of the hand is a curious disease first described by A. P. Cooper and later, in 1831, more completely described by Dupuytren, who called it "permanent contracture of the fingers."[1] It is characterized by chronic thickening and hypertrophy of the palmar fascia with formation of linear bands to one or more fingers, resulting in deformity of the hand and impaired function. We will describe very briefly the principal features of the disease and present a simple operation that we have found satisfactory in selected cases.

FIG. 1. Case of Dupuytren's contracture illustrating position of the finger.

FIG. 2. Longitudinal parallel incisions have been made along the edges of the contracture.

The cause of this contracture is obscure. It has been attributed to hormonal and nervous disturbances, to inflammation of unknown origin, and to trauma. Cases have been reported in which endocrine dysfunction is present, while others have been noted in connection with diseases of the central nervous system. Lund[2] has noted its frequency in epileptics and has stressed possible hereditary causes. An inherent susceptibility to inflammation of fibrous tissue has been advanced as an explanation.[3] We and others have noted an apparent relation to trauma in many cases. Most of our patients are seamen engaged in heavy manual labor and their hands are subjected to frequent and repeated injury. Some of them gave a history of a single injury to which they attributed the onset of the deformity, but others noted the condition for the first time when it was mature, and could recall no trauma.

* Approved for publication by the Surgeon General, U. S. Public Health Service.

The disease usually begins in the ulnar half of the palm and affects the ring and little fingers most frequently. Sometimes it involves all the palm and all fingers. It is often bilateral and symmetrically placed. Thickening begins in the palmar fascia, usually in a localized area at the base of a finger where a subcutaneous nodule may be formed. Thickening extends from the skin and subcutaneous tissue through the palmar aponeurosis to the tendon sheaths but rarely involves the tendon proper. The process extends progressively and insidiously until the palmar aponeurosis becomes replaced by diseased fibrous tissue. Extension into the digital slips occurs frequently. Retraction of diseased tissue results in puckerings of the skin, more nodule formation, and flexion deformity of the fingers. (Fig. 1.) The digits are first flexed at the metacarpophalangeal joints and later the interphalangeal joint may become involved either through disease or disuse so that therapy is of little avail. The disease having thus begun in one palm may appear in the other or may appear simultaneously in both. A given contracture often does not progress to joint involvement but may remain for years stationary with little resulting disability.

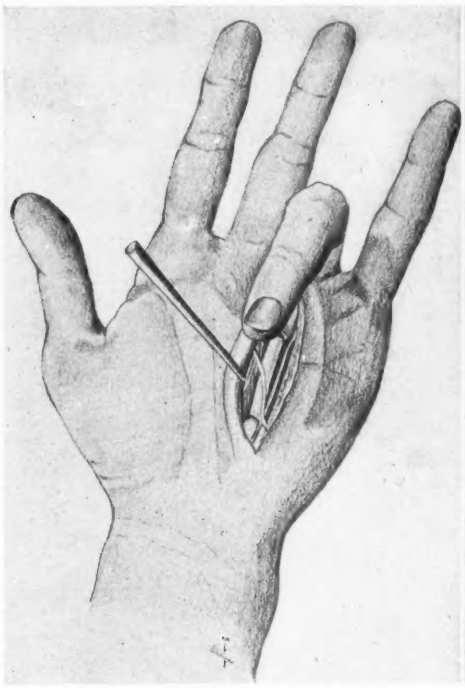

FIG. 3. The bridge consisting of skin and diseased tissue has been raised.

FIG. 4. A graft has been placed beneath the bridge.

Although this condition is admittedly insidious and slowly progressive, it is remarkable how some men become adjusted to it and are reluctant to seek relief. Some of our patients presented themselves for treatment only after having been refused employment on the basis of resulting disability, then in advanced state. Since the cause is unknown and the course variable, it is difficult to predict the course in an early case. But since severe cases of long standing may be difficult or impossible to correct surgically, we have tended to favor early treatment if any limitation of extension of a finger is present.

For treatment of Dupuytren's contracture, radiation, physiotherapy, and operative procedures have been advocated. Volavsek[3] and Feurstein[4] report good results with radium emanations in a small number of patients. Formerly, massage, local heat, and passive exercises were used, but in our experience they have been useless. Many earlier writers and most recent

ones agree that operative relief is the only means of cure. Dupuytren himself recommended excision. Most authors recommending operation have emphasized that the diseased fascia must be excised in its entirety, either by subcutaneous dissection through one or more transverse incisions or by excision of the fascia and closely adherent skin intact.[5] Skin grafts are often used to cover defects created by complete excision or to replace non-viable flaps. Skinner has advocated complete dissection of the fascia from the skin and use of a tunnel graft.[6]

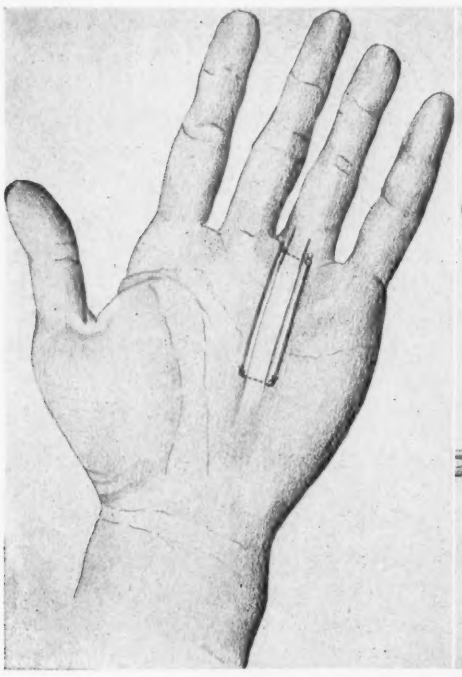

Fig. 5. Diagrammatic representation illustrating extension of the finger and bridge holding pressure on graft.

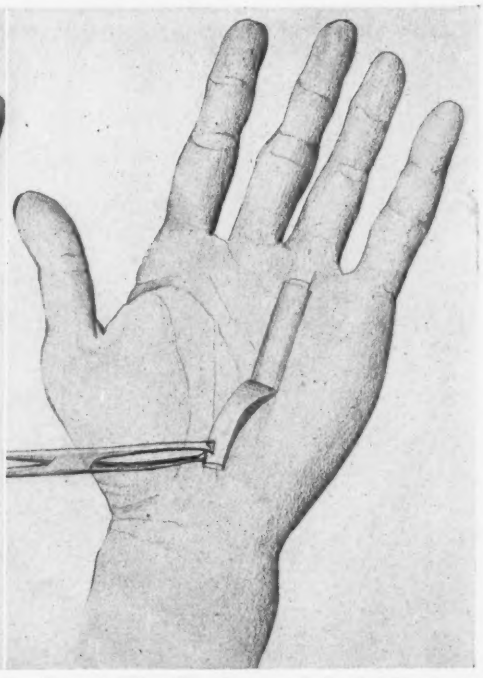

Fig. 6. The distal part of the bridge has been cut away leaving the healed graft in place. The proximal end will also be cut away and the raw edges of skin stitched to the graft. This stage of the operation may be performed under local anesthesia, using a few drops at each end of the wound.

Dissecting the diseased palmar fascia in its entirety and freeing it from the closely attached skin is a time-consuming and tedious procedure. In order to avoid this we have attempted to perfect a simpler method. In the "bridge operation" described here, the contracture, together with its overlying skin, is lifted *en masse* and a graft applied beneath. After raising the bridge, extension of the finger is possible in properly selected cases, and such extension causes the bridge to exert firm even pressure on the graft. At a later date, when the graft has taken, the diseased bridge is excised. This operation cannot be used for all types of the disease but is most useful where there is a single band of contracted fascia limiting extension of one finger, as shown in the figures. It may be used for more than one finger if each is limited by its own individual band; but if great extension and fixation of the joints has occurred, this procedure is useless.

The patient should be in good general condition and the skin everywhere free from infection. The hand and forearm are prepared by scrubbing with soap and water and by washing with saline solution and ether. A blood pressure cuff tourniquet may be used. The hand and forearm are draped to the elbow. Parallel longitudinal incisions are made on either side of the contracting band (Fig. 2) and are extended proximally and distally until they enter normal tissue. The incisions are beveled

inward slightly. A bridge of tissue connected to normal skin at its proximal and distal ends is then created by undermining

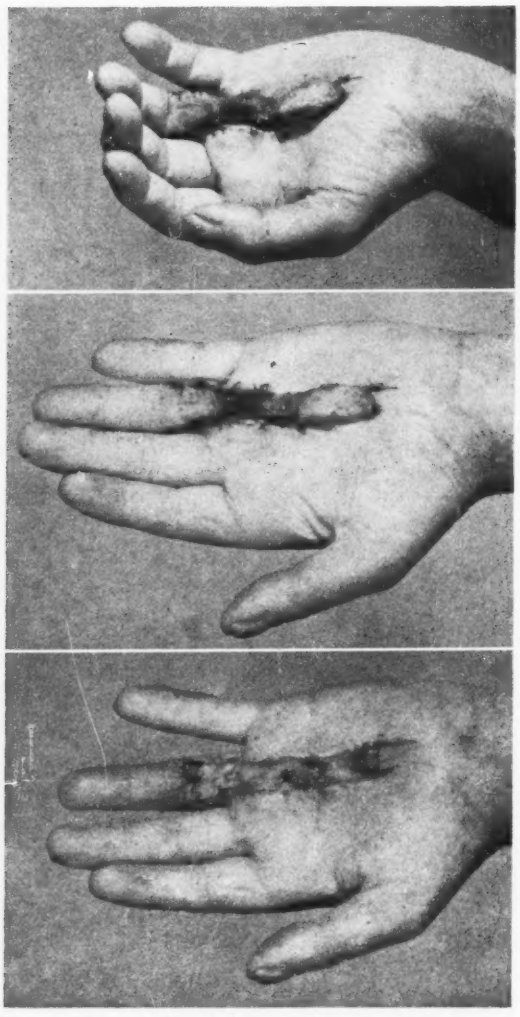

FIG. 7. The bridge of diseased tissue is shown with the edge of the graft visible on the radial side beneath.

FIG. 8. Extension of the finger is possible even though transverse division of the contracture has not been made. Necrosis occurs in center of a long bridge. Case shown at time of first dressing ten days after operation.

FIG. 9. Tenth day postoperatively; the bridge has been excised.

the diseased fascia, together with its skin, between the two parallel incisions. (Fig. 3.) In this dissection digital vessels and nerves may be encountered and must be preserved. When the bridge has been made, extension of the finger is possible although no transverse division of the contracture has been made. The tourniquet is loosened and hemostasis is secured. A suitable donor site is selected (the forearm is already draped and available) and a free graft is cut. A full thickness graft may be used and the donor area closed, or a thick split graft may be cut from the thigh with a dermatone. A full thickness must be accurately fitted to the defect but a split graft may overlap. The graft is inserted beneath the bridge and may be secured with a few fine silk stitches although suturing is not necessary. (Fig. 5.) Dressings are applied and the fingers are splinted in extension. At the end of ten days to two weeks the graft should have taken. Under local anesthesia the bridge of tissue is divided from its proximal and distal connections (Fig. 6) and the graft is sewed to the new skin edges at each end. The splint need not be reapplied, and the patient is encouraged to begin active exercise. The following is an illustrative case:

## CASE REPORT

E. E., a merchant seaman, age 55, No. 62191, was admitted for treatment of limitation of extension of the left fourth finger. The general examination showed no abnormalities but local examination of the hand showed "a flexion contracture of the ring finger. On attemped extension a rigid cord-like band stands out on the palm, leading to the base of the finger. It feels somewhat knobby and irregular. Extension is limited to about 135 degrees." The diagnosis was early Dupuytren's contracture involving the left ring finger. For this case the bridge operation was employed, using a free full thickness graft. The graft healed kindly, losing superficial layers of skin in two areas. Figures 7 and 8 illustrate the appearance of the wound at the first dressing on the tenth day. The bridge with underlying graft is shown. Figure 9 shows the appearance of the graft after excision of the bridge. Extension of the finger is complete.

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# THE RESPONSE TO PREOPERATIVE IRRADIATION AS A CLUE TO THE MANAGEMENT OF BREAST CANCER*

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THE rôle of radiation in the treatment of breast cancer is a controversial one. The value, or lack of value, of preoperative irradiation has not been established despite the large amount of literature and the clinical experience that has accumulated. Even the term "preoperative" seems to have no definite meaning. It has included all technics, from doses so small as to be almost homeopathic, to amounts so large that grave damage has been done, and serious sequelae have resulted. Some have used it only to modify the most sensitive cells before surgery, while others have attempted a cure with irradiation alone.

The present article is an attempt to clarify one phase of the enormously complex problem of cancer of the breast. In 1938, Coutard[1] pointed out that "technical operability does not necessarily mean actual operability." He emphasized the great gap that might lie between technical operability and biological operability. Surgery, Coutard maintained, achieved its best results in the relatively insensitive tumors. It was he who suggested irradiation be used as a means of distinguishing these types.

This seems not to have met with any general acceptance. Indeed Adair[2] dismisses preoperative irradiation on such grounds as ". . . the morbidity (from radiation therapy), poor wound healing, and fibrosis of the lung." He also writes that "only 35% of the cancers located in the breast proper were sterilized (sic) by modern divided dose methods." This reveals a quite different attitude toward the function and desirable amounts of preoperative irradiation than that held by O'Brien,[3] Bell, Edson and Hornick[4] Dann and Koritschoner,[5] and others.

O'Brien[3] has well summarized the situation: "Following literally the method employed by Adair, one would have to expect the untoward results described by him, but it should be recalled that he purposely used large doses of intensive radiation to obtain data on the cancericidal effect of *X*-Rays on the tumor in the breast and axillary nodes." O'Brien, as well as others, including the author, doubt that "sterilizing" doses are "either desirable or necessary."

The present report is an attempt to determine if Coutard's clinical impression is borne out in a series of unselected patients. During the period of 1938 to 1944, 131 cases of proven breast cancer were given preoperative irradiation in the Radiology Service of the Los Angeles County Hospital.

The customary daily dose was 300 r (in air) given through a 10 by 10 cm. supraclavicular and to each of two opposing breast portals (usually 10 by 15 cm.) for a total of 1800 r each. The axillary field (10 by 10 cm.) received 1500 r. The factors were, 200 K.V., 50 cm. T.S.D., Cu. 0.5 mm., plus Al. 2 mm., H.V.L. 1.0 Cu. The intensity was 35 r per minute.

The skin effect of this program was seldom more than a brisk dry erythema. The operative procedure was performed four to six weeks later.

The tumors of fifty-three (33 per cent) of these patients underwent striking regression under this treatment. That is, there was such a marked diminution in the

* From the Tumor Board and Department of Radiology, Los Angeles Therapeutic Hospital.

size of the mass that it was noted as being only "an indefinite thickening" or "no palpable tumor." Of these fifty-three patients, twenty-nine (54.7 per cent) then had radical mastectomies, while twenty-four (45.3 per cent) had no subsequent surgery.

In this hospital our follow-up is far from ideal. The natural history of breast cancer being as capricious as it is, added to the difficulty of an assay of our results. It was decided to use for this study, as the single point of reference, the time interval after the start of irradiation to the development of recognizable metastasis. It is realized that some of these patients may never develop metastases but, nevertheless, the results are rather striking.

The following cases have been followed for periods ranging from six months to six years:

TABLE I
SURVIVAL OF IRRADIATED PATIENTS HAVING RADIOSENSITIVE CARCINOMA, WITH AND WITHOUT SURGERY*

| Surgery | No. of Cases | Survivals | Survivals, Per Cent |
|---|---|---|---|
| Radical mastectomy | 29 | 11 | 45 |
| None | 24 | 14 | 56 |

* There were no deaths immediately attributable to the surgery.

TABLE II
AVERAGE TIME AFTER TREATMENT TO THE APPEARANCE OF METASTASIS IN IRRADIATED PATIENTS WITH RADIOSENSITIVE CARCINOMA, WITH AND WITHOUT SURGERY

| | Months |
|---|---|
| Irradiation plus radical mastectomy | 10.77 |
| Irradiation alone | 16.22 |

The above data are not materially affected by the comparatively small number of cases and length of their follow-up. No consistent correlation was found between the histology and the radiation response.

From the above it appears that there is evidence to support the belief that in highly radiosensitive breast tumors, Stages II (i.e., with axillary adenopathy) and III (i.e., with skin involvement), surgery is prone to disseminate the disease with the earlier appearance of metastasis. These data are the more remarkable in view of the fact that the patients having "preoperative" irradiation but no subsequent surgery, were in much poorer general condition than those who were operated upon. Indeed, it was only debility that prevented their having radical surgery.

None of this makes us believe that irradiation offers a happy future for these patients. However, it does lead us to the conviction that the surgical results in this group of radiosensitive tumors are apt to be particularly unfortunate.

In view of the foregoing support of our long standing clinical impression, the following outline has been adopted by the Tumor Board of this hospital:

PLAN FOR THE MANAGEMENT OF BREAST CANCER

*Stage I.* Localized in breast.
Immediate radical surgery, unless specific contraindications exist:
(a) Pregnancy
(b) Lactation
(c) Grave systemic disease

*Stage I.* Clinically but *Stage II* Pathologically:
Postoperative irradiation as soon as possible.

*Stage II.* Metastasis to axillary nodes.

*Stage III.* Involvement of skin of breast.
Preoperative irradiation for a period of not to exceed two weeks.
(a) If the tumor mass shows very little regression at the end of this period, the patient is then to have immediate radical surgery followed by postoperative irradiation.
(b) If the tumor shows marked radiation re-

sponse at the end of the two-weeks period, preoperative irradiation is to be continued and if, after irradiation has been completed and a suitable time interval has elapsed, a residual mass remains in the breast, the patient is to have radical surgery.

(c) If, at the end of the "preoperative" irradiation, there remains in the breast no palpable evidence of tumor, the patient is to have no subsequent surgery.

*Stage IV.* Fixation of lesion to chest wall. The treatment of these patients is to be considered individually by the Tumor Board.

*Stage V.* Distant metastases, to lungs, bone, liver, etc.

Treatment either by irradiation or medical palliation, as the case may require.

It is understood that unusual cases shall be considered individually by the Tumor Board, and that the above policy may, in special instances, not be followed rigidly.

## SUMMARY

1. A series of 131 cases of breast cancer have been studied to determine if the response to preoperative irradiation gives any clue to their best management.

2. Irradiation as the sole therapeutic agent in cases of highly sensitive breast tumors appears to delay metastasis.

3. Our present plan of classification and treatment for breast cancer is presented.

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# Case Reports

## MIKULICZ'S DISEASE*

### A REPORT ON A PATIENT TREATED WITH PENICILLIN

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TRUE Mikulicz's disease is rare. The literature contains reports of many cases simulating the disease described by Mikulicz, but it is questionable whether they should be classified as such. In the session of January 23, 1888, Mikulicz presented the first description of this disease before the Society for Scientific Medicine at Königsberg. His case presentation was as follows:

"Both lacrymal glands and all the salivary glands were changed in a symmetrical manner into tumors, which pushed themselves markedly forward from the normal position of these organs and thereby distorted the physiognomy of the patient in a remarkable way. The tumors had arisen gradually; they were at the time of examination of a hard consistency, painless, without trace of inflammatory signs. Moreover, elsewhere there were present no pathological changes in the bearer of these tumors . . . I found not a single observation similar to mine recorded in the literature . . . Seven months previously, in June 1887, he noticed that both upper eyelids began to swell; he had no pain or other trouble, except that with the increased swelling, opening of the lids was rendered difficult. Later the palpebral fissure became so much narrowed that it was difficult for him to see. Soon afterward there appeared under both angles of the jaw, similar painless swellings, which as they grew larger, interfered with eating and speaking . . . In the blood there is no striking change, especially no leukocytosis . . . The countenance appears strikingly altered because of the symmetrical swelling in the region of the upper eyelids, the parotid and the submaxillary glands. The upper eyelids hang down so far, especially in their outer halves, that the palpebral fissure is reduced to a narrow, triangular space, with base formed by the inner two-thirds of the lower lid . . . the patient is unable perceptibly to raise the upper lid himself, even with strong effort . . . Under each angle of the jaw projects a tumor about the size of a hen's egg, covered by normal, moveable skin . . . If the patient opens his mouth, attention is drawn at once to tumors corresponding to the two sublingual glands . . . During the examination, a copious secretion of saliva takes place, but there is otherwise no sign of salivation existing."

This detailed description of the disease, which has been named after the surgeon who so clearly portrayed it, like many classical descriptions, has never been improved upon. The powers of observation of scientists of past generations seem to have been more highly developed and their descriptions more minute and painstaking.

It is obvious from a study of the literature that some of the authors either were not familiar with this classical description by Mikulicz or that they considered this observation to cover a wide field. Consequently, we find that many cases have

* From the Jackson Clinic, Madison, Wisconsin.

been reported under the title of Mikulicz's syndrome and include leukemias, tuberculosis, syphilis, etc. Finally, Shaffer and Jacobson presented the following classification:

1. Mikulicz's Disease
   - (a) Familial
   - (b) Mikulicz's disease proper
2. Mikulicz's Syndrome
   - (a) Leukemia
   - (b) Tuberculosis
   - (c) Syphilis
   - (d) Lymphosarcoma
   - (e) Toxic
     - (1) Lead
     - (2) Iodides, etc.
   - (f) Gout
   - (g) Febris uveoparotidea subchronica

This classification surely includes many diseases of the neck. But to me it is confusing and misleading, and I do not believe Mikulicz had anything like this in mind when he presented his classical description.

Rather I think we should look upon Mikulicz's disease as one characterized by a benign, symmetrical, painless enlargement of the salivary and lacrimal glands, a normal blood picture and frequently accompanied by a soreness and dryness of the mouth and tongue. Obviously cases including an abnormal blood picture, as the leukemias, and those including changes in the lymphatic glands, as tuberculosis, should not be included. It is true that involvement of the lacrimal and salivary glands may occur in leukemia but as such is merely a local manifestation of a general blood disease.

Dixon believes that syphilis is the primary cause of Mikulicz's disease and reported a case showing response to antiluetic treatment. However, syphilis has not been found to be the etiological factor in most of the reported cases nor was that true in the case herein reported. Rather I would think that the occurrence of syphilis in Dixon's case was merely coincidental and that improvement might either have been spontaneous, as sometimes occurs, or the result of iodide therapy.

Mikulicz believed that he was dealing with an infectious disease, and no one has ever disproved this theory. On this basis the patient in the case which I am reporting was treated with penicillin although in a number of instances favorable response has been reported from *x*-ray therapy. It is possible that the disease might extend from the salivary glands to the lacrimal by way of the nasolacrimal duct since the mucous membrane of the mouth is continuous with that of the conjunctival sac. The conjunctivitis noted in my case would seem to corroborate this original idea of Mikulicz's. Fever, however, is not characteristic but has occasionally been reported to occur.

This disease may occur at any age but is most common in early adult life or in middle age. Howard, studying a series of forty-one cases of true Mikulicz's disease collected from the literature, found the youngest patient to be five and one-half years of age and the oldest to be seventy-seven years of age. The average age of this series was thirty-three. The series showed the disease to be more common in the male, the ratio being 26 to 15.

The most striking features of the disease as it appeared to me were the peculiar appearance of the face with the narrowed palpebral fissure, the symmetrical enlargement of the salivary glands, and the parchment-like dryness of the tongue. This characteristic triad of symptoms should enable one to establish a diagnosis quickly and easily of this rare condition.

Eyesight is not disturbed as a rule unless the tumor mass is so large as to make it difficult for the patient to open his eyes.

The general health of the patient is good in marked contrast to most disease conditions of the neck and mouth. On the other hand, the lack of saliva causes considerable discomfort in the way of mastication of food, swallowing, singing, etc.

The prognosis is variable. In some of the reported cases the condition persisted for

months or even years with periods of remission and then finally subsided.

Various methods of therapy have been tried including surgery, *x*-ray, iodides, etc. As far as I know, the case reported here is the first in which penicillin has been tried. I could find no reports of the use of the sulfonamides although my patient had been unsuccessfully treated before being referred to me.

Smith reported operating upon a patient in 1924 and removing the left submaxillary gland. He believed this to be malignant and followed the operation by deep *x*-ray therapy. However, a year later the tumor returned. At this time both parotid glands were removed, and a diagnosis of Mikulicz's disease was established by Le Count. The patient experienced no further trouble. Cure was likewise established by surgery in the case reported by Lehman and Leaman.

In recent years deep *x*-ray therapy has yielded successful results, and reports of patients so treated have been made by Pfeiffer, Evans and Leucutia, Hodges, Wright, Hamilton, Pohle, Miller and Eusterman. Two patients were successfully treated with radium by Pinch.

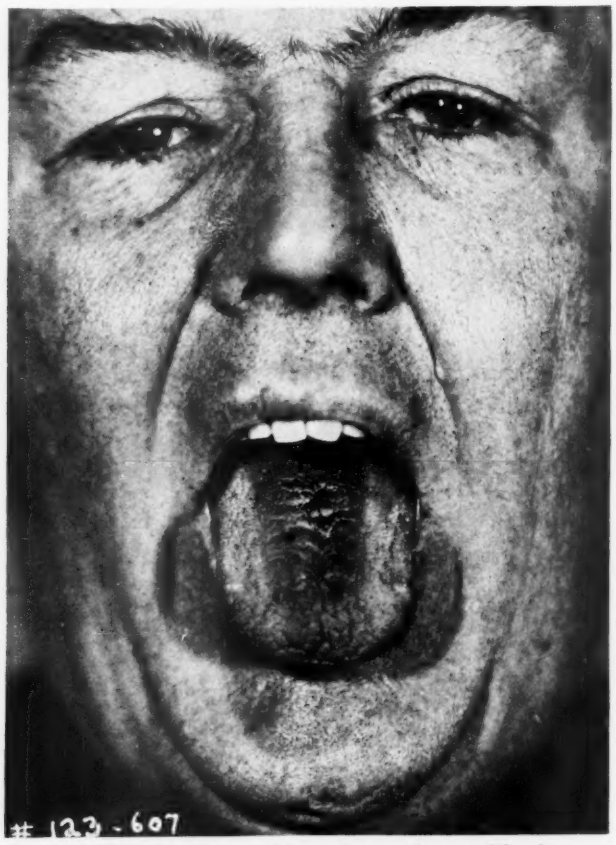

FIG. 1. Mikulicz's disease. Note the parchment-like dryness of the tongue, the swelling of the salivary glands, and the narrowing of the palpebral fissures.

Arsenic and iodides have been tried with varying success. Some of the cases that responded were undoubtedly true cases but belong in the syndrome group being luetic in origin.

The pathological picture is typical, the true glandular tissue being replaced by lymphocytes either in section or throughout the whole section. Connective tissue may be marked in some cases and is probably an indication of a more advanced state. The process appears to represent a chronic inflammatory one although it is believed by some observers to be indicative of a benign neoplasm. Boyd is of the

opinion that the condition may be regarded as a localized form of lymphoblastoma. Ewing's conception that the cervical and axillary nodes, spleen and liver are often involved in the later stages and that many of the symptoms resemble those of Hodgkin's disease is certainly in contrast to the classical picture of Mikulicz's. Miller and Eusterman take exception to the assumption held for years that the disease in the original case of Mikulicz's was benign and self-limited. To them this view hardly seems tenable since lymphoid tissues may diminish in the presence of an overwhelming infection and dehydration such as Mikulicz's patient must have had. In their opinion there will always be some doubt as to the ultimate diagnosis in Mikulicz's original case as the patient died of peritonitis from "perityphlitis" just two months after the second excision of recurrent lacrimal tumors and fourteen months after the onset of the illness. During the nine days of the terminal illness the swelling of the parotid glands practically disappeared. Because the histologic picture in the orbital nodule removed for biopsy in the Miller-Eusterman case was almost identical with the histopathologic findings described in Mikulicz's original case, they question whether his case was actually a benign self-limited process. In a further discussion of the subject from a roentgenological standpoint, Leddy states that Mikulicz's disease is best regarded for purposes of roentgen treatment not as a specific entity but rather as a manifestation of lymphoblastoma.

## CASE REPORT

Mr. C. M., aged fifty-two, came to the Jackson Clinic on August 21, 1944 complaining of extreme dryness of the mouth and lumps on his neck which he had first noted three weeks previously. He thought it had begun when he yawned and the muscles of his neck seemed to tighten. The following day he noticed the glands of his neck were swollen, and he called his local physician, who gave him a sulfa drug with no apparent improvement. Two weeks prior to his coming to the clinic the saliva stopped flowing, and he consulted other physicians who tried various remedies including hypodermic injections, electric treatments, mouth washes, etc., without success. The swelling of the glands increased to such an extent that he found it very difficult to open his mouth; his eyes were nearly swollen shut and his voice, likewise, was affected.

On examination, general physical findings were normal except for the following: There was a rather marked enlargement of the sublingual, submaxillary and parotid glands. The enlargements were smooth and not tender but sufficiently large to interfere with speaking and eating. "There was symmetrical swelling in the region of the upper eyelids. . . . The upper eyelids hung down so far, especially in their outer halves, that the palpebral fissure is reduced to a narrow, triangular space with the base formed by the inner two-thirds of the lower lid. The patient is unable perceptibly to raise the upper lids himself even with strong effort."

On first examination the patient was able to open his mouth only enough to see the tongue with some difficulty, but after a few days treatment he was able to open his mouth sufficiently so that one could see the tongue characteristic of the parched dryness of Mikulicz's disease. His voice had a husky note. Because of the dryness of his entire mouth he said his diet was almost entirely liquid. His temperature was 99.6°F. Urinalysis and blood count as follows: specific gravity 1.010, reaction acid, sugar negative, few red blood cells. Hemoglobin 81 per cent, erythrocytes 3.99, leucocytes 10,550, lymphocytes 15, large mononuclears 4, transitionals 3, neutrophiles 76, eosinophiles 2. *X*-ray of the submaxillary areas: "Roentgenograms of the parotid and submaxillary areas revealed no evidence of salivary calculi."

The complete picture suggested an acute stage of Mikulicz's disease with the typical enlargement of the salivary glands, absence of saliva, conjunctivitis, and narrowing of the palpebral fissures, the painless, non-tender glands which were firm and smooth and not adherent to the surrounding structures and the ptosis of the eyelids. His general health was good except he found it impossible to masticate.

A review of the literature revealed that there was considerable conjecture regarding the classification of cases of true Mikulicz's disease

and those considered under the Mikulicz's syndrome. Some cases had responded to surgical treatment, others to *x*-ray therapy. I was unable to find a report on any patient successfully treated with the sulfonamides. Although the etiology of the disease has remained a mystery, in many ways it suggests a low-grade infection of the salivary ducts. Therefore, it was decided to try penicillin therapy. He was given 100,000 units diluted with 20 cc. of sterile, physiological saline solution. He was given 5,000 units per cc. concentration each twenty-four hours, the dosage being 2 cc. intramuscularly every three hours night and day for seventy-two hours. Treatment was started August 22nd and on August 25th the patient noted that saliva began to flow and that the glands were rapidly receding. He was able to open his mouth wider, could eat solid food, chewing meat, etc., for the first time in four weeks. The conjunctivitis was receding also. In view of the mild, secondary anemia which was present, he was given Kapseals Ventriculin with iron and vitamin B capsules, one three times daily.

On September 5th, it was noted that the salivary glands were nearly normal in size and there was a further improvement in the eyes but the tongue seemed drier. He was re-admitted to the hospital and was given another 100,000 units of penicillin. On September 9th his condition generally seemed to be improved, but it was noted that there appeared to be a cycle of three or four days' duration when the tongue was dry, then becoming moist again. Further improvement of the eyes was noted, and he no longer complained of a burning sensation. Because of the intermittent flow of saliva it was decided that he be given a course of radium over the region of the left salivary glands. He was given a dosage of 350 mg. hours over two areas and was to return for further treatment of the right salivary gland area in three weeks but reported that he had so sufficiently improved that he did not think it necessary.

It is not possible to say conclusively that penicillin effected a cure in this case as sufficient time had not elapsed before the use of radium. It is certain that the swelling of all the salivary glands and conjunctivitis had subsided before radium was used and that the flow of saliva had commenced so that he was able to open his mouth fully and properly masticate solid food.

On November 2, 1944, the patient reported that the flow of saliva is normal except when he awakens in the morning, that his eyes have entirely cleared up and that he is now working six days a week and feeling very well. He is able to eat beef steak, tenderloin steak and enjoy it. He has rejoined his singing group and is able to carry on normally in that respect.

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# SOLITARY DIVERTICULITIS OF THE CECUM

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SOLITARY diverticulitis of the cecum is an uncommon lesion as judged by the few cases reported. The lesion in the majority of cases is preoperatively diagnosed as appendicitis. It is frequently a difficult lesion to diagnose at the operating table and is most commonly mistaken for carcinoma of the cecum with the result that radical surgery is performed.

In 1943, two articles appeared in American literature with case reports, reviews of the literature, and analytical studies of diverticulitis of the cecum.[1,2] Only those cases of solitary diverticula are included in this report. A few cases have been recorded in which there was inflammation of a single diverticulum of the cecum in the presence of other non-involved cecal diverticula. In these instances the pathological process was the same as in true solitary diverticulitis. The symptoms were characteristically those of an acute inflammatory lesion of the right lower quadrant. Baker and Carlile[2] found thirty-seven cases of true solitary diverticulitis of the cecum in the American and British literature and added two of their own making a total of thirty-nine in their series. They[2] did not include the six cases of solitary diverticulitis reported by Schnug in their series. We have in the past year encountered three cases. The addition of these nine cases brings the number reported to forty-eight.

Diverticula of the colon are classified as either true (congenital) or false (acquired); the latter is classified as either primary or secondary. The wall of the true diverticulum contains all of the layers of the normal intestinal wall. The false diverticulum shows the absence of one or more muscular layers. Diverticula of the left half of the colon are not unusual; they are found in about 5 per cent of all persons over forty years of age.[3,4] However, diverticula confined to the cecum alone are unusual. Greensfelder and Hiller[5] made some interesting observations on the etiology of false secondary or traumatic cecal solitary diverticula and reported four cases. They concluded this type of diverticulum resulted from (1) eversion of the cecal wall between two constricting adhesive bands, (2) traction of a narrow adhesion on the cecal wall, (3) eversion at the stump site of the appendix due to migration of silk purse-string sutures into the cecum and (4) eversion at the appendiceal stump site the result of weakness following rupture of a stump abscess into the lumen of the bowel.

The greatest number of solitary cecal diverticula was found on the lateral and anterior cecal wall. A few were located on the medial and posterior wall. Including our cases, twelve were reported as true diverticula and eleven false; in twenty-four sufficient data were not available to determine the type; in one of our cases the type could not be determined. A fecalith was found in the diverticulum in twenty-one (43.75 per cent) of the reported cases; in the others it was not found or not mentioned.

The preoperative diagnosis in over three-fourths (77.08 per cent) or thirty-seven of the forty-eight cases, including our own, was appendicitis. Five of the thirty-seven were thought to be appendiceal abscess and one stump appendicitis. In three instances cancer was the preoperative diagnosis; in the remaining group no definite statement was made except in one instance, an abscess of undetermined origin.

The type of operation performed including our three cases was diverticulectomy twenty; resection of the cecum and/or ascending colon sixteen; inversion of the

diverticulum four; cut adhesions one; closure of perforation two; anastomosis or drainage three; and extraperitonealization of abscess one. In this group of forty-eight cases there were only two deaths; one was in the group of colon resections, and one was due to bronchopneumonia following drainage of a pericecal abscess.

The disease occurs in the male and female with about equal frequency. About one-half of the reported cases were in individuals under forty years of age; about one-half were over forty years. Our three cases fell in the third decade.

Symptomatically, acute cecal diverticulitis is acute appendicitis. Twenty-two patients (45.83 per cent) had previous attacks of lower abdominal pain. About one-third of the patients will have epigastric or generalized abdominal pain at the onset with subsequent localization in the right lower abdomen. However, the right lower abdominal pain was usually crampy in character. In the table of comparisons of the symptoms of acute appendicitis to those of acute diverticulitis[1] nausea and vomiting occur about half as frequently in diverticulitis as in appendicitis. In cecal diverticulitis practically all had tenderness in the right lower quadrant on examination, and about 80 per cent had muscle spasm. In a rather large percentage a mass was detected. The average temperature was about 99.6°F. with a pulse average between 80 and 90. The white blood count varied from normal to over 22,000, the average being about 12,700. The average white blood count in the series of appendicitis reported by Reid, Poer, Merrel[6] was 17,200.

As previously pointed out, practically all the patients in the cases reported were operated upon with a diagnosis of acute appendicitis. But with the abdomen opened, the pathological findings in many instances were much more extensive than simple local inflammatory involvement of a diverticulum, and difficulty in diagnosis arose. The lesion had developed into a large firm indurated mass that involved the cecum and had an appearance resembling carcinoma of the cecum. When one considers that cancer is next in frequency to appendicitis as a lesion of the cecum, the reasons for the mistakes made in the diagnosis and radical resections performed are understandable.

With a large mass of the cecum, palpation of the mass through the opposite cecal wall may reveal the mouth of the diverticulum. This was of value in one of our cases in establishing the diagnosis of cecal diverticulitis at the operating table. Baker and Carlile point out it will aid in the differential diagnosis if the three types of malignant tumors of the bowel are kept in mind, i.e. the type that grows by cauliflower-like projection into the bowel lumen and is very slow to metastasize, the type that grows by true extension through or along the various coats of the bowel and is more likely to show glandular metastasis, while the third type rapidly ulcerates through the bowel and shows many glandular metastases.

In tuberculosis of the cecum, as a rule the ileum is also involved, and sometimes small tubercles can be seen on the serosa. The peritoneum is usually thickened and adhesions are present. The lymph glands are large and caseous.

Other more rare lesions as actinomycosis and so-called simple ulcer (non-specific ulcer) of the cecum may have to be considered in the differential diagnosis. The former condition may start in the appendix or cecum. Early, there is thickening of the cecal wall and little abscesses and sinuses form. If the sulfur granules can be found, the diagnosis is established. Simple ulcer usually occurs on the medial wall of the cecum as pointed out by Barrow,[7] Wilkie,[8] and Cameron.[9] This lesion has been reported slightly more frequently than solitary diverticulitis. This lesion, like diverticulitis, may present a picture suggesting malignancy with the result that right colectomy has been done. Those who have written on the subject believe that surgery for this lesion should be minimal.

Treatment of acute diverticulitis has varied from no treatment, drainage of pericecal abscess, diverticulectomy, inversion of the diverticulum, to resection of the cecum and right colon. The mortality has been low in this series of forty-eight cases. Only two deaths have occurred; one followed right colectomy, and one was from bronchopneumonia and cardiac failure following drainage of a pericecal abscess. Because of the tendency of diverticulitis to recover spontaneously, no extensive surgery is ordinarily necessary.

Burgess[10] points out that the course of diverticulitis is to subside without perforation or other complication. Of the five cases that came under his observation, two had appendectomy at operation, but no surgery to the diverticulum. In one instance (previous appendectomy) he made a clinical diagnosis of cecal diverticulitis and did not operate; the diagnosis was confirmed by *x*-ray on the second hospital day. The patient recovered. Schnug reports a case of an acute diverticulitis on the lateral cecal wall which was not disturbed at operation, but the appendix was removed, and the patient recovered. Another patient in his series had a pericecal abscess which was drained. The patient died on the fourteenth postoperative day of bilateral pneumonia and cardiac failure. At postmortem the inflammatory process in the diverticulum and the surrounding cecum had subsided completely.

Schnug, after his analytical review of this subject, stressed the importance of doing only minimal definitive surgery and even this, in most cases, was probably not advisable. In our experience with three cases we did diverticulectomy twice and inversion of the diverticulum once.

## CASE REPORTS

Case I. A white male, age twenty-six, was admitted to the hospital February 17, 1943, complaining of a constant right lower abdominal pain with increasing severity of twenty-four hours' duration. About fourty-eight hours before admission, he was seized with a mid-abdominal, crampy, sharp pain which was followed by a brief period of nausea but no vomiting.

Examination revealed a slender, rather poorly nourished individual complaining of right lower quadrant pain. Temperature was 99.8°E. pulse rate 86. The heart and lungs were normal. The abdomen was flat; there was acute tenderness, moderate muscle spasm in the right lower quadrant with both local and referred rebound tenderness in the right lower quadrant. Brittain's sign was positive. The abdomen had a slightly doughy feeling. The examination of the blood showed red blood cells 4.2 million, hemoglobin 80 per cent, white blood cells 14,200 with 85 per cent polymorphonuclears. The urine was negative. The preoperative diagnosis was acute suppurative appendicitis.

The abdomen was opened through a McBurney incision. The cecum was markedly injected, and a mass the size of a large walnut was present on the anterior cecal wall approximately three inches distal to the appendix on the tenia. The omentum was plastered to this firm mass. After the omentum was freed from the cecum, considerable fibrinous exudate was present. The mass was a diverticulum of the cecum and contained a fecalith which measured by palpation roughly 1.5 by 1 cm. The fecalith was manipulated into the lumen of the bowel. The diverticulum was inverted by a purse-string suture. The appendix showed slight serosal injection; it was removed.

The postoperative course was entirely uneventful. On the twenty-third postoperative day a barium enema was done which was negative for diverticula.

Case II. A white male, age twenty-seven, was admitted to the hospital on June 20, 1943, complaining of abdominal pain. For about two weeks the patient had been having mild, right lower, crampy abdominal pain, associated with slight nausea and diarrhea. He had six or seven loose, soft stools daily for four or five days. After this period, he was more or less constipated. For the past two days the pain in the right lower quadrant had been constant but not particularly severe. There was some loss of appetite. In the past two years he had had four similar attacks that lasted about four days each.

Examination revealed a well nourished and developed individual who appeared to be in no acute pain. Temperature was 97.4°F. and pulse

56 on admission. The heart and lungs were normal. The abdomen was flush with the thoracic cage and there was slight tenderness in the right lower quadrant on moderately deep palpation. Rectal examination revealed nothing abnormal. A blood count showed red blood cells 4.95 million, hemoglobin 95 per cent, white blood cells 10,550 with 76 per cent polymorphonuclears. A urinalysis was normal. An emergency stool examination revealed 4+ occult blood, and no parasites or ova were found. The impression was that we were probably dealing with a low grade appendicitis. He was kept under observation. The following morning, June 21, 1943, the pain and tenderness in the right lower quadrant were definitely increased over the preceding day. Proctoscopy was negative. Another blood count showed 10,350 white blood cells with 62 per cent polymorphonuclears. The temperature was 98.8°F., and the pulse rate 88. Because of the increased pain and tenderness, a diagnosis of acute appendicitis was made.

The abdomen was opened through a McBurney incision. A firm mass covered by an indurated greater omentum was found on the anterior wall of the cecum opposite the ileocecal valve. The anterior cecal wall was rather friable, and there was rather marked vascularity. The omentum close to the mass was divided, the mass was then freed to a pedicle which measured about 1.5 cm. in diameter. Diverticulectomy was done and the defect was closed with two rows of continuous catgut sutures. The appendix was retrocecal, showed no gross abnormality, and was removed.

Microscopically, the diverticulum showed hyperemia of the serosa with an inflammatory reaction in the wall. This was associated with hemorrhage and edema. The inflammatory reaction was acute and composed chiefly of polymorphonuclear leukocytes diffusely infiltrating the wall including the mucosa. The muscularis mucosa was present. The outer layer contained muscle fibers which were present both in longitudinal and cross sections. The pathological diagnosis was diverticulitis of the cecum (true or congenital diverticulum) and fibrous appendix.

The postoperative course was uneventful except for mild paralytic ileus which was controlled easily with Wangensteen suction and prostigmine. Postoperative stool examinations were negative. A barium enema was done about twenty-three days after operation and was entirely negative.

Case III. A white male, age nineteen, was admitted to the hospital August 6, 1943, complaining of right lower abdominal pain. About twenty-four hours before admission, the patient was seized with generalized abdominal cramps associated with slight nausea. After about six hours the cramps disappeared and left him with residual soreness in the right lower abdomen. His blood count five hours before admission showed 13,000 white blood cells with 80 per cent polymorphonuclears. He was sent to the hospital by his family physician with a diagnosis of acute appendicitis. About four years previously, the patient had a similar attack that lasted one day, but it was not as severe as the present one. His present abdominal complaint was the first in four years.

Examination revealed a well developed and nourished individual complaining of right lower abdominal pain which was aggravated on cough or change of position. His temperature was 99°F. and pulse 100. The heart and lungs were normal. The abdomen was slightly scaphoid, and there was definite localized acute tenderness with slight rigidity in the right lower abdomen over McBurney's point. There was slight rebound tenderness, locally, and referred rebound tenderness from the left quadrant to the right lower quadrant. A blood count showed white blood cells, 11,850 with 78 per cent polymorphonuclears. The urine was negative. The preoperative diagnosis was acute appendicitis.

The abdomen was opened through a McBurney incision. The cecum was lying rather high but could be delivered into the wound. The entire cecum was moderately inflamed. On the lateral wall of the cecum just opposite the tenia there was an indurated, endematous, and markedly inflamed structure which measured about 3.5 cm. in diameter. Palpation of the mass through the medial wall revealed a depression which felt like an ulcer or an opening into a diverticulum. The mass was dissected free down to a rather narrow neck that communicated with the bowel; this entire mass was resected. The defect in the wall was closed with two rows of continuous Lembert type sutures. There was no enlargement of the mesenteric glands. The appendix was retrocecal, coiled on itself, and bound to the posterior cecal wall by congenital bands; it was inflamed and gave

the appearance of a periappendicitis; it was removed. Five gm. of sulfanilamide crystals were sprinkled into the operative area, and the wound was closed.

Microscopic sections of the diverticulum showed a small abscess formation. In one area there was a mucosal surface with glands lined by columnar cells which contained globules. The muscularis mucosa was fragmented. There was an occasional small lymph follicle in the mucosal zone. The outer layer contained muscle fibers which were present in longitudinal and cross sections. There was a diffuse inflammatory infiltration in the entire wall with a small area of necrosis which almost completely replaced the wall. There was purulent exudate on the serosal layer. A section of the appendix showed perivascular lymphocytic infiltration with numerous leukocytes in the serosal layer with edema in this zone. There were scattered lymphocytes and leukocytes in the muscular coat. The lymph follicles and mucosa were intact. The diagnosis was acute diverticulitis of the cecum (congenital type diverticulum) and peri-appendicitis.

The postoperative course was uneventful except that the patient ran a low grade fever for the first ten postoperative days. A barium enema done twenty days postoperatively was negative.

## COMMENT

Twenty-two patients out of forty-eight reported cases of solitary cecal diverticulitis had previous attacks of lower abdominal pain. Two of our three patients gave definite histories of previous attacks. Another striking feature was the frequency (43.75 per cent) in which a fecalith was present in the diverticulum. Fecaliths, no doubt, (mechanically as in appendicitis) play an important rôle in the etiology of acute cecal diverticulitis. When diverticulitis does occur, it does not always remain a simple localized cecal diverticulitis as evidenced by the extensiveness of the inflammatory process in some of the reported cases. Diverticulectomy has been performed twenty times and inversion four times with no important morbidity and no mortality. In order to prevent future attacks, the solitary diverticulum should be removed or inverted when such treatment is feasible. If the inflammatory reaction is too extensive for simple excision or inversion, reliance on spontaneous recovery is preferred to the more radical operative procedures.

## SUMMARY

1. Solitary diverticulitis of the cecum is an uncommon lesion and in the majority of the reported cases has been preoperatively diagnosed as appendicitis, and at the operating table has been frequently diagnosed as carcinoma of the cecum.

2. A total of forty-eight cases has thus far been reported in the American and British literature.

3. Solitary diverticulitis occurs with about equal frequency in the male and female and occurs in most age groups.

4. Minimal surgery should be done because of the tendency of diverticulitis to subside spontaneously; however, diverticulectomy or inversion of solitary diverticulum should be done if possible.

5. Three cases of solitary diverticulitis of the cecum are reported, two of which were true or congenital diverticula, one could not be determined. Two were treated by diverticulectomy and one by inversion.

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# POSTOPERATIVE PHYSIOLOGICAL CHANGES IN REGIONAL ILEITIS*

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THE symptomatology, pathology, and treatment of regional ileitis have been described in the classic papers of Crohn, Ginsberg and Oppenheimer[1] and subsequent writers on the subject.[2–5] The purpose of the present report is to discuss the physiological variations noted in two cases recently observed simultaneously in the wards of this hospital. A review of the available literature has failed to reveal mention of these changes which one would assume must be fairly common in similar patients treated by two-stage operations and which pose interesting problems in postoperative management.

## CASE REPORTS

CASE 1. The patient age twenty-one, was admitted June 3, 1944, complaining of tenderness of his entire abdomen, particularly around the umbilicus and in the right lower quadrant, and cramp-like pains which occurred every fifteen to twenty minutes. These symptoms were of eleven months' duration and were accompanied by weakness, easy fatigability, loss of twenty-five pounds in weight, anorexia, and polydipsia. He stated that he had no desire to defecate when the cramps occurred but had five or six loose stools a day. There was no nausea or vomiting and no blood has been noted in the stools.

In July, 1943, while serving as an aviation cadet in the Army, he began to notice persistent pain in the right lower quadrant and a diagnosis of subacute appendicitis was made. On July 16, 1943, he was operated upon in an Army Hospital but the appendix was not removed because "the ileum was found to be red and injected with numerous glands the size of peas." After five months of supportive treatment in Army Hospitals, he was invalided from the service. Following his discharge in December, 1943, he took a job as a clothing salesman but was forced to quit in April, 1943, because of the recurrent attacks of abdominal distress.

Previous medical and the family histories were irrelevant.

Physical examination revealed a well developed, poorly nourished white adult who appeared chronically ill. During the course of the examination he had recurring spasms of cramps every ten to fifteen minutes which caused him to grit his teeth. Temperature was 100°F., pulse 104, respirations 20, blood pressure 106/60. The abdomen presented a well healed transverse operative cicatrix in the right lower quadrant. Even light palpation of this area resulted in severe voluntary spasm of the muscles of the abdominal wall; true rigidity was also present. The intestines were moderately dilated and an audible gurgling and rumbling sound was noted after each spasm of pain. No definite mass could be made out. On rectal examination tenderness was elicited on the right but no mass was felt. The physical examination was otherwise essentially negative.

Laboratory data: Erythrocytes 4,240,000; hemoglobin 11 G.; leucocytes 8,100 with a differential of 1 myelocyte, 9 band and 58 segmented forms, 29 lymphocytes, and 1 each of eosinophiles, basophiles and monocytes. Urinalysis was normal; the sedimentation rate was 28.

A gastrointestinal *x*-ray series after a barium meal revealed considerable delay in the small bowel "either in the terminal jejunum or ilium; at the end of 6 hours a small amount of barium is seen in the colon but the ilium appears to be remarkably distended, especially on the left side." A barium enema was not remarkable.

During the week following admission the temperature varied from 99 to 101°F. with a pulse rate of 80 to 110. A second blood count

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revealed an increasing anemia, and two transfusions were given.

On June 21, 1944, an exploratory laporotomy

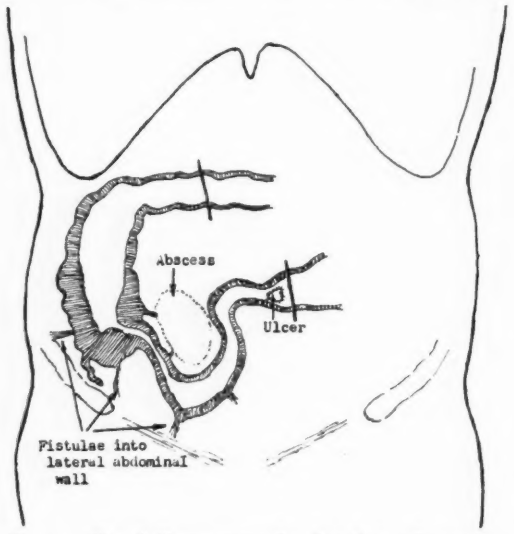


FIG. 1. Semi-diagrammatic drawing of condition found at operation and amount of bowel removed in Case 1.

was done under spinal anesthesia. The abdomen was opened through a right pararectus incision. A large mass which was overlaid with adherent omentum was encountered in the right iliac fossa with extension into the pelvis. After freeing the omentum the mass was dissected free from the lateral abdominal wall and delivered into the incision. It was found to consist of a large loop of ilium and the cecum which surrounded a mass the size of a lemon in the mesentery. Several sinus tracts between the mass and the lateral abdominal wall were encountered. The ileum was traced cephalad until healthy tissue was found and was divided between clamps. The ascending colon and hepatic flexure were mobilized and the transverse colon was divided between clamps just distal to the flexure. A double-barreled ileocolostomy was then formed in accordance with the Lahey technic[6] and brought out through the upper end of the incision. After peritoneal toilet, including the introduction of sulfanilamide crystals and a Penrose drain into the pelvis, the abdomen was closed in layers about the ileocolostomy. Figure 1 is a semi-diagrammatic representation of the condition found at operation and the amount of bowel removed.

A clamp was applied to the spur on the seventh postoperative day and, after two subsequent applications, the spur was cut down sufficiently to provide a good stoma between the small and large bowel. The final closure of the colostomy was postponed until September 4, 1944, because of the development of considerable irritation of the abdominal wall caused by the intestinal discharges. Following several days of preoperative preparation with succinylthiazole, the ileocolostomy was freed down to the peritoneum and closed with two layers of chromic catgut and a layer of seroserous mattress sutures of fine stainless steel wire. During the closure the peritoneum was inadvertently opened. Through-and-through wire sutures were passed through the layers of the abdominal wall to the peritoneum but were not tied. The incision was packed with vaseline gauze after frosting with sulfanilamide crystals and the sutures tied several days later. Healing by second intention occurred promptly.

At the present time the patient is asymptomatic and has gained forty pounds in weight. With the exception of two small sinuses which extend only through the skin at the lower end of the incision and which are healing, the abdominal incisions are firm.

CASE II. A seaman first class, age twenty-three, was admitted March 27, 1944, because of a fistula-in-ano of four months' duration which apparently followed an ischiorectal abscess. Previous medical history was negative except for an appendectomy in 1924 at the age of three. Physical examination revealed a well nourished and well developed white adult who did not appear acutely ill. His temperature was 99.6°F., pulse 96, respirations 16, blood pressure 110/44. The examination was otherwise essentially negative except for a draining fistula which opened externally on the right buttock and internally into the anal canal. On March 31, 1944, the fistulous tract was laid open. Convalescence was uneventful, although the tract healed slowly, until May 28th when he began to complain of epigastric pain which was relieved by food. Sometime around this date he complained for the first time of pain in his abdomen, but when it was found that his appendix had been removed, not much attention was paid to it. He continued to complain of abdomina discomfort and on June 6th a series of gastrointestinal *x*-rays following the ingestion of a barium meal revealed a deformity of the duodenal bulb that appeared to be caused by extrinsic pressure. On the six-hour film "there is a rather unusual appearance of the lower pole of the cecum" and a barium

enema was advised. *X*-ray of the chest was negative.

On June 12th, a mass which apparently involved the cecum was made out on physical examination for the first time. Rectal examinat on confirmed the presence of a large indurated mass in the right iliac fossa. A blood count revealed 3,720,000 erythrocytes, hemoglobin 10.5 Gm., leucocytes 9,400 with a differential count of 6 band and 71 segmented forms, 22 lymphocytes and 1 basophile.

A barium enema on June 13th failed to fill out the cecum at any time during the examination. The films showed "a filling defect in that area and a definite tumor can be felt." The gastrointestinal series was repeated on June 17th and the presence of a deformed duodenal cap confirmed. In addition, "there is some distention of the jejunum but we could not demonstrate any narrowing of any part of the small bowel. The barium entered the cecum at the end of 2½ hours but there still remained some barium in the ileum and no abnormal intestine was seen in the region of the mass in the right lower quadrant. The mass which could be palpated appeared to involve the lower part of the cecum and terminal ileum and was responsible for the slow emptying of the terminal ileum. . . The tumor moved with the cecum and we believe it is part of the cecum. The incompletely filled termineal ileum and cecum did not have the characteristic picture of ileitis. It does not appear to have the appearance of tuberculosis or of a malignant lesion. We believe the tumor is a non-malignant inflammatory mass."

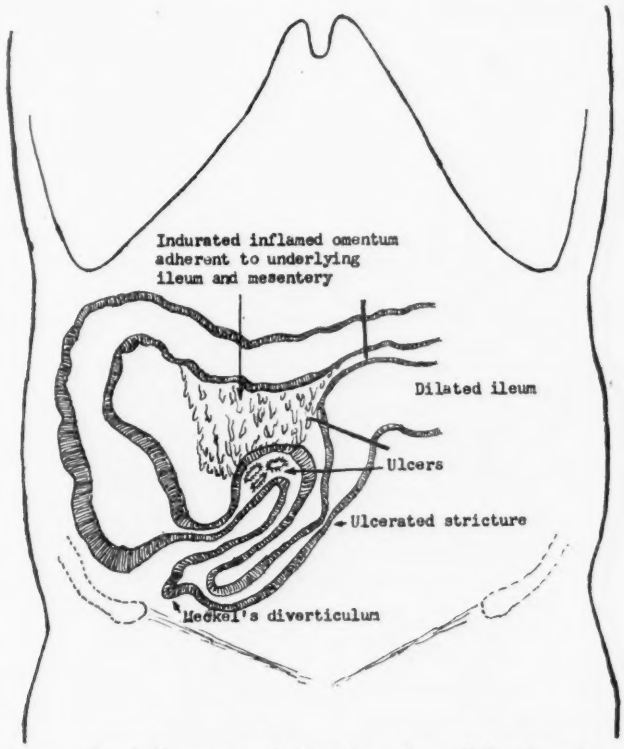


Fig. 2. Semi-diagrammatic drawing of condition found at operation and amount of bowel removed in Case 11.

During this period of observation, the temperature chart showed an occasional rise to 100°F. with a pulse rate of around 80 per minute. A blood count on June 24th was reported: erythrocytes 4,180,000; hemoglobin 84 per cent; white blood cells 14,250. Sulfadiazine was given with some apparent improvement and the mass in the right lower quadrant appeared to decrease in size. During the last five days in June, however, the temperature curve began to show a low-grade septic course which increased to 101°F. on July 6th.

A skin test with 0.1 cc. of a $\frac{1}{20}$ dilution of O.T. on July 3rd gave a negative reaction. On July 7th, it was noticed that the mass was again increasing in size and that the patient had lost seven pounds during the last two weeks. The red cell count dropped to 3,570,000

and a transfusion was given. Other laboratory data at this time were recorded as follows: stool negative for ova and parasites; sedimentation rate 26, gastric contents negative for acid-fast bacilli; non-protein nitrogen 25.3 mg. per cent; blood chlorides 465, serum protein 7.01.

On July 11th an exploratory laporotomy was done under metycaine spinal anestheisa. On opening the abdomen a large inflammatory mass involving the terminal ileum, cecum, ascending colon, and part of the transverse colon was found. This mass was densely adherent to the greatly thickened parietal peritoneum. The mesentery of the terminal ileum and the mescolon were thickened and edematous. A large amount of free peritoneal fluid was present. The terminal ileum, cecum, ascending colon and half of the transverse colon were mobilized and resected. A Lahey-Mikulicz type of ileocolostomy[6] was done and the abdomen closed in layers without drainage. Figure 2 is a semi-diagramatic representation of the findings at the operation and the amount of tissue removed.

The postoperative course is discussed below. Following a suggestion made by Fauley and his associates,[7] penicillin was started intramuscularly in doses of 20,000 units every three hours and plasma and blood transfusions were given. For the first two days postoperatively the highest temperature was 99°F.; on the third day some abdominal distention became apparent and the temperature rose to 100°F. A Levine tube was introduced. The temperature remained elevated for three more days with a rise to 103°F. on the morning of the sixth postoperative day, and then fell to normal where it remained during the remainder of the convalescent period.

On the sixth postoperative day the "spigot" of the ileocolostomy was removed with the cautery and a clamp applied to the spur. Two subsequent applications of the clamp were made until an adequate stoma was obtained. The ileocolostomy was closed on September 11, 1944 after several days of succinylthiazole medication and healed by first intention.

At the present time the patient has no complaints except two to three loose stools a day. He has gained thirty pounds since operation but is not yet back to his normal weight.

## COMMENT

Histological examination of the tissues removed at operation in these two cases revealed the picture usually encountered in regional ileocolitis. Areas of mucosal destruction with necrosis and polymorphonuclear infiltration were associated with areas in which fibrosis with diffuse invasion of small round cells, plasma cells, large numbers of eosinophiles, and polymorphonuclear cells were prominent. Occasional foreign body giant cells were present but there was no evidence of malignancy or tuberculosis.

After combating the initial surgical shock resulting from the extensive resections carried out in these two cases, the most serious problem encountered in the postoperative period was that of extracellular dehydration. While such problems are to be expected in patients with ileostomies and have been recognized in other discussions in the literature, the difficulty in controlling the water and electrolyte balance in the two cases described seemed much greater than would ordinarily be expected in procedures of this type.

Tables I and II record the variations in the hematocrit, blood chlorides, and serum protein that occurred in the postoperative course of these patients. The quantities listed under "Intake" include the amounts of fluids taken by mouth and administered parenterally and does not include an estimation of the water content of the foods ingested or of water of oxidation. Similarly, the "Output" comprises the volume of urine excreted and the vomitus as well as the ileostomy drainage up to the seventh postoperative day when the projecting limb of ileum was removed and does not include the drainage from the ileostomy after that date nor the water and electrolytes lost from excessive sweating and attacks of diarrhea. All laboratory studies were made in the morning hours so that the fluids administered each day are reflected in the succeeding days' tests.

It will be noted that when an increase in the hematocrit is shown, the serum protein also increases but in most instances the blood chlorides decrease. In other words, hemoconcentration in these cases was

accompanied by a decrease in blood chlorides rather than an increase as would ordinarily be expected. It is our opinion that the hemoconcentration here is caused by the extensive loss of the sodium and chloride ions from the body with a resulting extracellular dehydration. As the loss of electrolytes through the intestinal drainage exceeded the supply, the extracellular spaces, of which the fluid portion of the body is a part, were called upon to furnish the difference. In order to maintain the proper concentration of the remaining electrolytes, the fluid volume of the blood is reduced and hemoconcentration occurs.

When the volume of the circulating blood reaches the critical level there may be a sudden circulatory collapse and the

TABLE I

| Days P.O. | Hematocrit | Blood Chloride | Serum Prot. | RBC | Intake | Output* | I.V. Glucose Saline | Plasma Cc. | Whole Blood Cc. | |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | .... | ... | .... | ... | 5250 | 500 | 4000 | 250 | 1000 | Moderate surgical shock |
| 1 | 38.0 | 522 | 6.12 | ... | 6000 | 800 | 6000 | | | |
| 2 | .... | ... | .... | 3.8 | 4800 | 650 | 4000 | .... | 500 | |
| 3 | .... | ... | .... | 4.2 | 3800 | 1600 | 2000 | | | |
| 4 | 49 | 454 | 7.14 | ... | 5310 | 1525 | 3000 | .... | 500 | Profuse ileostomy drainage |
| 5 | 44 | 486 | 6.64 | ... | 4110 | 1955 | 3000 | | | |
| 6 | .... | ... | .... | ... | 1960 | 1760 | .... | .... | ... | Drainage tube removed from ileum |
| 7 | .... | ... | .... | ... | 2580 | 2760 | .... | .... | ... | Vomiting |
| 8 | .... | ... | .... | ... | 3320 | 1020 | .... | .... | ... | High protein diet |
| 9 | 51 | 412 | 7.70 | 4.0 | 5400 | 425 | .... | .... | 500 | |
| 10 | 46 | 484 | 6.74 | ... | 2460 | 1000 | | | | |
| 11 | .... | ... | .... | ... | 2340 | 1900 | | | | |
| 12 | .... | ... | .... | ... | 1630 | 460 | | | | |
| 13 | 48 | 446 | 6.86 | ... | 1430 | 825 | .... | .... | ... | Profuse ileostomy drainage |
| 14 | .... | ... | .... | ... | 2280 | 1430 | | | | |
| 15 | 47 | 461 | 6.92 | ... | 2225 | 1220 | | | | |
| 16 | .... | ... | .... | ... | 2430 | 1175 | | | | |
| 17 | .... | ... | .... | 4.7 | 2475 | 1390 | | | | |
| 18 | 50 | 412 | 7.60 | ... | 2790 | 1795 | 2000 | 250 | | |
| 19 | 47 | 432 | 7.42 | ... | 2400 | 1660 | | | | |
| 20 | .... | ... | .... | ... | 2200 | 1595 | | | | |
| 21 | 52 | 408 | 7.62 | ... | 2540 | 1200 | | | | |
| 22 | 43 | 429 | 7.32 | ... | 2360 | 525 | .... | 500 | | |
| 25 | 46 | 422 | 7.40 | 4.1 | 2640 | 1000 | | | | |
| 27 | 49 | 411 | 7.36 | ... | 2200 | 585 | .... | .... | ... | Vomiting and diarrhea |
| 29 | 54 | 396 | 7.67 | ... | 6000 | 2510 | 3000 | 1500 | ... | Shock BP 50/30 |
| 30 | 39 | 453 | 7.54 | 3.5 | 5100 | 2050 | 2000 | .... | ... | Cond. good BP 96/70 |
| 31 | .... | ... | .... | ... | 5150 | 2825 | 2000 | ... | 500 | BP 118/76 |
| 32 | 44 | 445 | 7.00 | 4.2 | 3650 | 1575 | .... | ... | ... | BP 116/76 |
| 34 | 53 | 430 | 7.20 | ... | 4990 | 2000 | 1000 | 250 | ... | Vomiting, diarrhea, marked weakness |
| 35 | 49 | 447 | 7.09 | ... | 4520 | 2025 | .... | .... | ... | Better, BP 100/74 |
| 36 | 48 | 404 | 6.97 | 3.8 | 4500 | 1640 | .... | 500 | ... | Weak BP 86/68 |
| 37 | 48 | 478 | 7.50 | ... | 4370 | 2025 | .... | .... | 500 | Better BP 104/76 |
| 39 | 52 | 396 | 7.58 | ... | 3460 | 1200 | .... | .... | ... | Vomiting, weak |
| 40 | 54 | 404 | 7.93 | 4.3 | 6540 | 2750 | 2000 | 500 | ... | BP 84/66 |
| 41 | 47 | 429 | 7.54 | ... | 4040 | 1350 | .... | .... | 500 | Improved BP 96/70 |
| 45 | 53 | 437 | 7.69 | ... | 4280 | 1425 | .... | 500 | ... | Vomiting BP 92/70 |
| 46 | 48 | 446 | 7.79 | ... | 4060 | 2500 | .... | .... | 500 | Better, drainage less, BP 94/72 |
| 49 | 47 | 453 | 7.5 | 4.1 | 3850 | 1550 | .... | .... | ... | Out of bed, BP 118/80 |
| 60 | 45 | 480 | 7.21 | 4.3 | .... | .... | .... | .... | ... | Walking; condition good—drainage from ileostomy slight; having regular bowel movements. |

* Drainage from ileostomy could not be recorded after removal of drainage tube on the seventh postoperative day.

typical picture of shock is presented. It is interesting to note that this is precisely what happened in Case 1 on the twenty-ninth postoperative day. For several days previous to this episode he seemed to be getting along exceedingly well, so well in fact that some of the daily laboratory checks on him were omitted. Then, suddenly, and without warning, serious surgical shock was precipitated. The picture was dramatically controlled by the rapid infusion of large quantities of plasma and normal saline given simultaneously but for several days thereafter the water and electrolyte balance were very difficult to maintain and it was frequently necessary to administer one or two units of plasma in addition to the saline to re-establish quickly the precarious equilibrium.

TABLE II

| Days P.O. | Hematocrit | Blood Chloride | Serum Prot. | RBC | Intake | Output* | I.V. Glucose and Saline | Blood Plasma Cc. | Whole Blood Cc. | |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | .. | 465 | 7.01 | 4.2 | 5100 | 550 | 3000 | 750 | 1350 | Moderate surgical shock |
| 1 | 41 | 412 | 6.21 | 4.4 | 5500 | 1735 | 5000 | ... | 500 | |
| 2 | 41 | 519 | 6.80 | ... | 3150 | 1500 | 2000 | | | |
| 3 | 39 | 412 | 6.67 | ... | 4850 | 5300 | 3000 | ... | 500 | Vomited |
| 4 | 39 | 445 | 6.30 | ... | 5610 | 5260 | 2000 | ... | .... | Vomited |
| 5 | 39 | 511 | 5.05 | ... | 5760 | 4580 | 2000 | | | |
| 6 | .. | ... | .... | 4.3 | 5640 | 8675 | 2000 | ... | 500 | Profuse drainage from ileostomy |
| 7 | 43 | 482 | 6.40 | ... | 5630 | 3225 | 2000 | | | |
| 8 | 45 | 462 | 7.59 | ... | 6460 | 3470 | 2000 | ... | .... | Clamp applied to septum |
| 9 | .. | ... | .... | ... | 6050 | 3325 | .... | ... | .... | Vomited |
| 10 | 45 | 404 | 6.71 | 4.7 | 6290 | 3700 | | | | |
| 11 | 42 | 402 | 6.80 | 4.1 | 3620 | 2600 | 2000 | ... | .... | Vomited 2000 cc. |
| 12 | 43 | 462 | 7.15 | 4.2 | 3000 | 1645 | | | | |
| 13 | 41 | 445 | 6.98 | ... | 5140 | 2280 | 1000 | ... | 500 | |
| 14 | 46 | 426 | 6.90 | ... | 4020 | 1050 | .... | ... | .... | Ileostomy drainage profuse |
| 15 | 51 | 404 | 7.30 | ... | 3240 | 2035 | | | | |
| 16 | 51 | 385 | 6.90 | 3.9 | 3190 | 1610 | 2000 | 500 | | |
| 17 | 45 | 495 | 6.70 | ... | 2640 | 1560 | .... | ... | 500 | |
| 18 | 47 | 429 | 6.90 | 4.3 | 2775 | 925 | | | | |
| 19 | .. | ... | .... | ... | 3200 | 1885 | | | | |
| 20 | 46 | 429 | 7.01 | ... | 4680 | 2580 | 2000 | ... | .... | Bowels moved through rectum |
| 21 | 47 | 453 | 7.78 | ... | 4700 | 2620 | | | | |
| 22 | 48 | 429 | 6.50 | ... | 5050 | 2700 | 2000 | ... | .... | Bowels moving B.I.D. |
| 23 | 46 | 432 | 6.24 | 4.6 | 4500 | 3015 | 1000 | ... | .... | Ileostomy drainage less |
| 24 | 47 | 420 | 7.05 | ... | 3800 | 2905 | | | | |
| 25 | 45 | 445 | 7.79 | ... | 3800 | 1700 | | | | |
| 26 | .. | ... | .... | ... | 3700 | 1480 | | | | |
| 27 | 46 | 429 | 6.90 | ... | 3510 | 1525 | .... | ... | .... | Bowel movements regular |
| 28 | 47 | 440 | 7.20 | ... | 3550 | 1460 | | | | |
| 29 | 46 | 445 | 6.16 | 4.9 | 3400 | 1425 | .... | ... | .... | Ileostomy drainage subsiding |
| 30 | 44 | 440 | 7.19 | ... | 3700 | 1400 | .... | ... | .... | Up and about |
| 34 | 44 | 445 | 7.30 | ... | 3900 | 1350 | | | | |
| 37 | 39 | 478 | 7.70 | ... | 3400 | 2600 | | | | |
| 42 | 40 | 480 | 7.60 | 4.7 | 2800 | 1200 | | | | |

* Ileostomy drainage not included in output after the seventh postoperative day because external portion of ileum had sloughed and drainage was then absorbed by dressings.

In neither of these cases were we able to maintain the blood chloride levels at the accepted normal values during most of the postoperative period. Attempts were made on several occasions to push sodium chloride by mouth as well as by venoclysis, but in each instance this resulted in

diarrhea which was usually followed by vomiting with a further loss of electrolytes. The balance was extremely sensitive throughout and could be controlled only by constant checking of the laboratory findings as well as the clinical condition of the patients.

Throughout the postoperative course of these two patients, the serum protein was maintained within fairly normal limits by repeated blood transfusions and plasma when indicated and by a high protein diet. Most of the variations noted in the tables are attributed to variations in the hemoconcentration.

## SUMMARY

Two cases of regional ileitis in which the patients were treated by extensive resections of small bowel and colon are described. In both cases the postoperative variations in the hematocrit, blood chlorides and serum protein were extremely difficult to control. Relaxation of the vigilance required may result in the appearance of typical surgical shock as late as the twenty-ninth postoperative day or, indeed, until the ileocolostomy is closed. A constant check of the water and electrolyte balance by laboratory methods is necessary to anticipate and control such variations by prompt administration of whole blood or plasma, before critical levels are attained.

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# COMPLETE AVULSION OF THE SCALP

## REVIEW OF THE LITERATURE AND CASE REPORT

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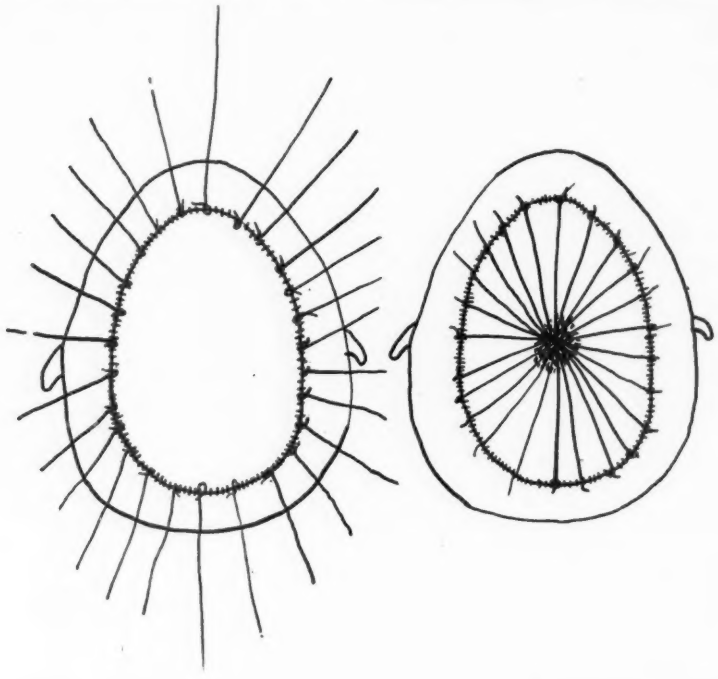
CASE reports of avulsion of the scalp are not uncommon in medical literature, yet, these reports are usually of interest. Luther Strayer,[1] in searching through the literature, found that in 1696 Augustin Beloste,[2] a great French Surgeon, advocated skull trephining to produce granulations after scalp avulsion. Beloste stated that, "In order to prevent the bone from becoming altered and carious . . . it is necessary at the first dressing or as soon as possible to pierce the bone in several places with the pyramid or perforator of the trephin; in this manner one gives passage to a marrow juice which, oozing out, covers the bone in a short time without loss of the least part of its substance." Boerhaave,[3] Vance and Robertson[4] in the eighteenth and nineteenth centuries advocated similar procedures. Downs reported the earliest case of industrial scalping in 1838. Netolitzki was the first to report the use of grafts in the treatment of avulsed scalps. Davis,[5] in 1911, summarized 132 cases of avulsion of the scalp. He found that in most instances the pericranium was uninjured and left intact, in fewer cases partial pericranial destruction occurred, whereas in only a few was the pericranium totally destroyed. Coleman[6] reported two cases in which the scalp with all of the pericondrium was destroyed by burns.



A B

FIG. 1. A, continuous running suture of catgut and interrupted heavy black silk sutures. B, black silk sutures tied over several thicknesses of gauze to form a stabile pressure dressing.

Scalping of their victims was practiced by early American Indians. Accidental

scalp avulsion has occurred from burns, animal claws and industrial mishaps. With the advent of women into mechanized industry, the possibility of industrial scalping has greatly increased.

## TREATMENT

The immediate treatment of avulsed scalps is the control of hemorrhage which may be severe. Pressure is the most satisfactory method until the patient can be brought to an equipped emergency operating room where the bleeders may be caught and ligated. Shock, anti-gas gangrene, and anti-tetanic therapy are essential. Skull radiographs and a thorough neurological examination should be performed to detect any cerebral injury. If the scalp is not completely avulsed and a pedicle remains, the flap should be shaved, thoroughly cleaned and disinfected. The margins should be débrided if ragged, and the flap sewn back to the head. A take usually ensues even though only a small pedicle is present.

Scalps which have been completely torn away from the head present the problem of attaining a satisfactory blood supply. The separation usually occurs in the subaponeurotic layer leaving the pericranium intact. After proper surgical preparation, the defect should be carefully examined to determine the state of the pericranium. The treatment of such cases falls into two categories: those in which the pericranium is intact, and those in which it is destroyed.

1. *Pericranium Intact.* If the scalp is severely macerated or impregnated with dirt or grease particles making it impossible to clean, it should not be replaced as the danger of infection with resulting meningitis is too great. However, should the scalp be obtainable in fairly good condition, the hair could be shaved off, and the scalp thoroughly cleaned and disinfected. It could then be washed in normal saline and reapplied. Davis[5] reported twenty-one attempts at such treatment with complete failure in all cases save one. Malherbe claimed the greater part of an avulsed scalp healed after replacement but his result is doubted. Lejars[7] commenting on Malherbe's case

Fig. 2. Photograph of the patient's avulsed hair.

stated, "That after careful disinfecting by shaving and brushing with soap and sublimate solution the scalp was readjusted and sutured. The scalp died but turned into a parchment like covering which remained adherent to the cranium and under which healing took place without complications . . . in such a case the reapplication is practically only a dressing with the skin."

The case to be reported was treated in a similar way. Approximately 75 per cent of the graft appeared viable after four weeks of observation. Shortly after a month, however, the surface of the graft assumed a brownish, dried out, tanned, contracted appearance. Eventually, the graft separated spontaneously yielding a granular base covered by a moderate purulent discharge. The granulations completely filled the defect. No temperature elevation or complication ensued. The reapplied scalp acted merely as an excellent protective dressing preserving the pericranium and allowing normal granulations to form.

Most reports in the literature describe reapplied scalps as becoming necrotic, infected and malodorous necessitating their removal. Others report their conversion into a parchment-like covering. Davis,[5] in his animal experiments, concluded "that granulations appear to grow well on the periosteum under the reapplied flap. For this reason alone then, the scalp might be replaced in toto after proper cleaning and free drainage, and if carefully watched and removed at the proper time would not cause infection, and might stimulate the growth of granulations on the pericranium." After the tan is removed, the granular surface should be surgically prepared for grafting. In this case the wound was dressed daily with a thin coating of sulfathiazole powder and a continuous wet pressure dressing of 1:3300 aqueous azochloramide for five days prior to grafting. The purulent discharge disappeared and the granulations became firmer and yellowish in appearance. A thin split-thickness graft was employed in this case. However, I believe a thick split-thickness graft would have been more suitable. The graft was cut, trimmed to pattern, and placed over the

FIG. 3. A, B, C, D and E, end result after skin grafting; two small anterior ulcers are evident.

defect. The best method of immobilizing the graft is to suture it either by the end-to-end or overlapping method to the periphery of the defect by a continuous running thin catgut suture. This is supplemented by interrupted heavy black silk sutures. Vaseline gauze and several additional thicknesses of gauze are then placed over the graft and the sutures tied. (Fig. 1.) Exuberant granulations or an unhealthy appearance of the granular layer may easily be corrected by repeated applications of a saturated solution of trichloracetic acid, vaseline gauze and a pressure dressing. Only gross manifest infection should delay grafting. However, when the granulations maintain a satisfactory appearance, grafting should be started. My recent experiences in grafting severely burned patients with marked infection have shown tissue culture to be unimportant. Wounds from which hemolytic and non-hemolytic streptococci, Bacillus proteus, Staphylococcus aureus and albus, have been isolated have accepted Thiersch and split thickness grafts well. If the granular surface appears healthy, it should be grafted in spite of a positive culture. It is also maintained by some authors that skin grafts will not take in patients whose hemoglobin or plasma protein level is low. I have found skin grafts to take well in spite of this. In severe extensive burns with marked toxemia, grafting has been highly successful even with the hemoglobin as low as 29 per cent and the plasma protein level at 5.3.

Mitchell[8] uses a sliding flap technic in avulsion cases. He advocates making numerous parallel relaxation incisions down to the pericranium. Several advancement flaps are thus formed, mobilized, shifted medially and approximated by tension sutures. The raw surfaces are allowed to granulate in and multiple operations are required. This procedure is only suitable for small and moderately sized defects.

Otto[9] describes the, "Great degree to which the remaining scalp may be stretched, if mobilized and drawn together in multiple stages allowing sufficient interval for compensation in the marginal scalp."

New and Erich[10] describe a method of,

Fig. 3E.

"reconstruction of lost portions of the scalp by employing hair-bearing pedicle scalp flaps. Unfortunately, such grafts have a limited degree of usefulness since they may be applied, in general, only to defects of comparatively small dimensions."

The defect may be thoroughly cleaned, treated with sulfa powder, packed with vaseline gauze and allowed to granulate in. Earlier surgeons began grafting immediately, placing the grafts directly upon the pericranium. This technic may be successful in many cases but has little or no advantage. The wound should be conservatively treated until the granulations have filled in the defect. Then after surgical preparation, it is ready to graft.

2. *Pericranium Destroyed.* If the pericranium shows a small tear or is only partially destroyed, the remainder may be elevated from the skull, the defect sutured, and treated as though the pericranium were intact.

If the scalp defect is small or of moderate size, a sliding advancement or rotation

flap consisting of the skin and superficial fascia may be used to cover the insufficiency. The remaining defect can then easily be skin grafted.

it." (2) Multiple small holes may be drilled through the outer table of the skull down to the diploe. Granulations will then grow through these holes filling in the defect.

FIG. A, B, C and D, patient with prosthetic hairdress manufactured from her own salvaged hair.

If the pericranial defect is very large, either of three methods may be employed: (1) Davis[5] advocates dressing "the uncovered bone with wet dressings, so that it will not dry out and become necrotic. A piece of rubber protective over the denuded bone will also keep the bone moist until the granulations have formed over

Rylander and Kisner[11] reported the case of a patient treated thusly and stated that granulations appeared twelve days after drilling and the wound was ready for grafting in fifty days. (3) A pedunculated flap may be taken from the back and transferred to cover the skull defect as advocated by Roberts[12] and Cahill.[13]

### SELECTION OF GRAFT

With the advent of the dermatome, large defects such as those caused by scalp avulsions, are no longer a problem. If a clear healthy appearing granular surface is present, the most suitable type of graft is a thick split-thickness dermatome graft. If the granulations do not appear healthy or a moderate granular discharge is apparent, a satisfactory result may be obtained by employing a thick Thiersch graft. A full thickness graft is ideal. However, the possibility of a complete take is less and the resultant donor defect is greater than the aforementioned types of graft. The thicker the graft, the lesser the tendency toward ulceration. Small recurrent ulcers may occur in Thiersch or split-thickness grafts, but these are not permanent and heal in short periods of time. In the case to be reported, two ulcerations occurred at the anterior part of the scalp which resisted therapy for several weeks. However, by compressed air therapy and a 5 per cent scarlet red ointment, these ulcers healed satisfactorily.

### CASE REPORT

Miss M. C., single, age twenty-one, was employed in a defense plant as a layout worker. On October 30, 1943, having none of her own duties to perform, was transferred to operate a drill press. As a layout worker, it was unnecessary to wear a protective covering on her hair. While operating the press, her hair became entangled in the machine behind her. She was pulled upward and backward toward the machine. The patient was knocked unconscious and the scalp completely avulsed. She then fell forward freeing herself from the machine. The patient has no recollection of the accident and the first thing remembered is being helped away from the press. A fellow worker then shut off the machine. Upon gaining consciousness she experienced a great deal of pain and felt as if the "top of her head were missing." Severe bleeding ensued. A towel was wrapped around the head and the patient taken to St. Elizabeth Hospital, Elizabeth, N. J.

Upon admission to the hospital the patient was fully conscious and in a slight state of shock. Her general condition was good. The blood pressure reading was 90/50, pulse rate was 105 per minute, and the temperature was normal. Radiographs revealed no fracture. Neurological examination revealed no abnormality. The pupils reacted to light and accommodation, and the eye grounds were normal. Examination revealed a scalp defect measuring eight inches square. The line of tear began one inch behind the normal forehead hair line and extended backward along the superior temporal line to the superior nuchal line. Multiple small lacerations and a linear laceration three inches in length extending downward over the right frontal region were also evident.

Dr. Thomas J. Walsh, attending surgeon, retrieved the scalp in five pieces. These were shaved, surgically cleaned, and washed in normal saline. Sulfathiazole crystals were sprinkled into the wound and the scalp pieces placed *in situ*, jig-saw puzzle fashion. They were sutured without paring. No elevation of temperature or pulse occurred and the blood pressure returned to a normal of 120/80 following the operation.

November 3, 1943, the patient complained of severe pain in the scalp with a throbbing headache. The wound was clear and sedatives were administered.

November 27, 1943, a copious purulent discharge was present around the periphery of each graft. Necrotic areas were also present in this region. Approximately 75 per cent of the grafts had a pinkish coloration and appeared viable. In the following weeks, the grafts became darker assuming a tanned appearance. Eventually, large dried tans formed. They separated spontaneously yielding a granular base on a level with the remaining intact scalp. The granulations were covered with a moderate discharge.

January 15, 1944, the wound was treated by daily applications of sulfathiazole powder and continuous wet 1:3300 azochloramide pressure dressings.

January 21, 1944, a .016 inch dermatome graft was taken from the abdomen and placed upon the granulations. The margins of the graft were attached to the scalp by a continuous running suture of No. 00 plain catgut. Heavy black silk sutures were then placed and tied over several thicknesses of gauze. A stabile pressure dressing was thus formed. The graft took well and the patient was temporarily

discharged from the hospital on February 4, 1944.

February 12, 1944, the patient was readmitted to the hospital and another .016 inch dermatome graft was taken from the abdomen, cut to pattern, and sutured into the remaining defect. The patient was discharged from the hospital on February 16, 1944.

Healing was satisfactory with the exception of a few small ulcerations which appeared from time to time. Two ulcers on the anterior portion of the scalp resisted treatment for a period of a month. Finally, however, under compressed air therapy and the application of a 5 per cent scarlet red ointment, these two healed satisfactorily.

After exposure to air, the graft, which was first livid white in color, assumed a healthy pinkish glow and blood vessels could be seen growing into the graft. Sensitivity is slowly returning from the periphery inwardly.

Fortunately, all of the avulsed hair was salvaged and employed in the manufacture of the prosthetic hair dress. A small piece of cloth is worn under the hairdress and changed daily. The patient's mental outlook is excellent. (Figs. 2, 3 and 4.)

## CONCLUSIONS

A totally avulsed scalp may be reapplied to the head after proper surgical preparation and serves as an excellent protective dressing preserving the pericranium and allowing normal granulations to form.

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# PYOPNEUMOTHORAX IN THE FIRST MONTH OF LIFE WITH RECOVERY*

## TWO CASE REPORTS

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THERE has been much discussion in the literature concerning empyema in children. The general conclusions are that it differs little from the ordinary adult type. Thus it is most frequently a sequel to pneumonia. Before the wide use of sulfa drugs, the most common causal organism was the pneumococcus,[2] but in recent years there has been a shift toward the staphylococcus. Hochberg and Steiner,[4] in a study of nineteen necropsies of children less than three months of age dying with empyema found the staphylococcus in 67 per cent of their cases, the streptococcus in 25 per cent and pneumococcus in 8 per cent. Most of these children had an associated widespread bronchopneumonia.

It is usually considered that mortality in infants is higher than in the older age groups. Mitchell[8] states that the mortality of empyema in children under one year of age is 50 per cent. Lanman and Dimmler[5] state that in the period from 1919 to 1934 their mortality rate in children under two years of age was 35 per cent. From 1934 to 1939 this rate dropped to 4 per cent. They attribute this to more intelligent management with closed drainage being the basis of treatment. Hochberg and Kraemer[3] in their analysis of 300 cases of empyema in children found a mortality rate in the first six months of life of 58 per cent.

As far as can be ascertained from a diligent search of the literature, empyema in infants under one month of age is an unusual condition, and it seems that the younger the infant the higher the mortality and the more difficult the management. Therefore, we believe that the following case reports present an unusual and interesting problem.

### CASE REPORTS

CASE 1. R. S., referred by Dr. John B. Bartram, was admitted on January 31, 1943, because of coughing, grunting respirations and fever. The baby was born in Temple University Hospital four weeks previously at a normal delivery. It was said by mother to have a "slight cold" when born, but the pediatrician could find no evidence of respiratory infection. No *x*-ray was taken. About ten days to two weeks before, respirations were somewhat grunting. About three days before admittance respirations became moderately labored and the baby seemed to be ill. Shortly before admission, it became short of breath, respirations were quite noisy, its color became dusky and temperature was elevated. The baby had been feeding from breast and was taking feedings well until two days previously when it seemed to become tired after a few minutes feeding.

Physical examination revealed the nutrition good but the child appeared critically ill. Respirations were 80 to 90 and quite labored. The skin was dry and there was a dusky, purplish-red cyanosis and marked retraction of interspaces on inspiration. Breathing was shallow, rapid, and most ineffectual. The heart was shifted markedly to left. Fine rales over both lung fields were heard. There was very little respiratory excursion on the right. Dullness to percussion over entire right side of chest was present.

The laboratory report revealed red blood cells 3.80, white blood cells 30,350, polymorphonuclears 76 per cent, non filaments 68, filaments 8, hemoglobin 12.5 Gm.

* From the Surgical Service, Temple University Hospital, Philadelphia.

*X*-ray on admission revealed complete pyopneumothorax on the right with marked shift of mediastinal structures to left almost obliterating the left lung. (Fig. 1.)

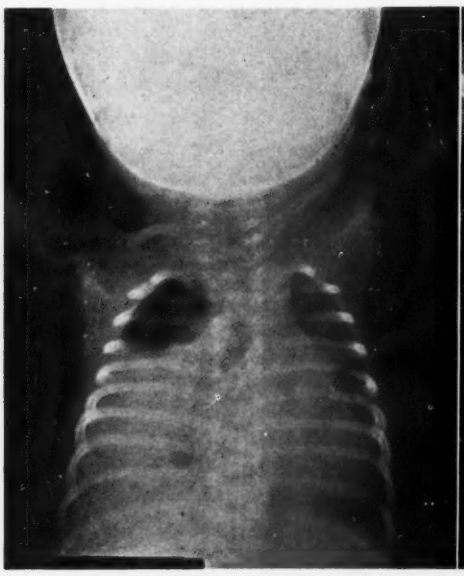

Fig. 1. *X*-ray of baby R. S. on admission. Note degree of mediastinal shift and presence of fluid and air in right pleural cavity.

Immediate aspiration of moderately thick gray pus and air from right thorax, gave some

Fig. 3. *X*-ray of baby R. S. approximately one year later showing normal chest.

relief. Culture revealed hemolytic staphylococcus aureus. Under local anesthesia immediate closed intercostal drainage was done on right side using trochar and canula. Relief was rapid. Suction of 30 cm. of water was applied to intercostal tube. *X*-ray the following day, February 1, showed much less fluid and air in

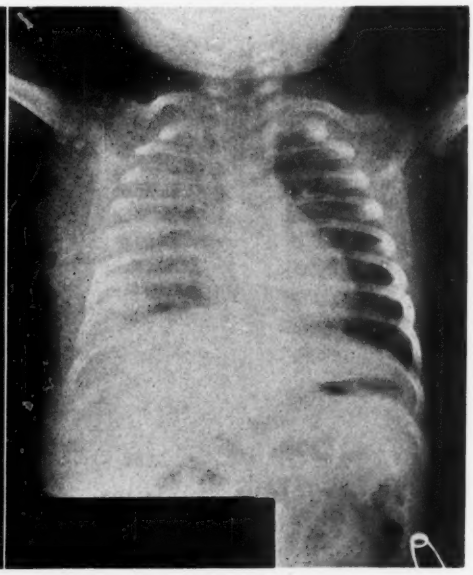

Fig. 2. *X*-ray of baby R. S. five days after rib resection and closed drainage with constant suction. Note marked improvement as compared with Figure 1.

the pleura and the baby was much improved. Sulfadiazine by mouth, 6 gr. per day for six days, was given. Improvement continued. *X*-ray two days later, (Fig. 2) showed loculated anterior collection with mediastinal structures in normal position. Clinically, the baby seemed excellent. On February 4th, this undrained collection was drained under local anesthesia through a rib resection located just anterior to the site of the intercostal drainage.

*X*-ray on February 5th, confirmed the thought that surgical drainage seemed satisfactory. At this time a small radiolucent area was first seen which appeared to be within the substance of the right lower lobe. However, improvement continued and the empyema cavity gradually became smaller until February 16th, sixteen days after admission, the drainage tube was entirely removed after *x*-ray on February 15th had revealed no pleural space demonstrable and the radiolucent area in the right lower lobe showed no change.

The baby had an occasional cough, but otherwise seems to be entirely normal. He was discharged from the hospital on February 21st, twenty-one days after admission.

Before discharge, it was decided that the cyst-like area in the right lower lobe should be watched carefully both clinically and by *x*-ray.

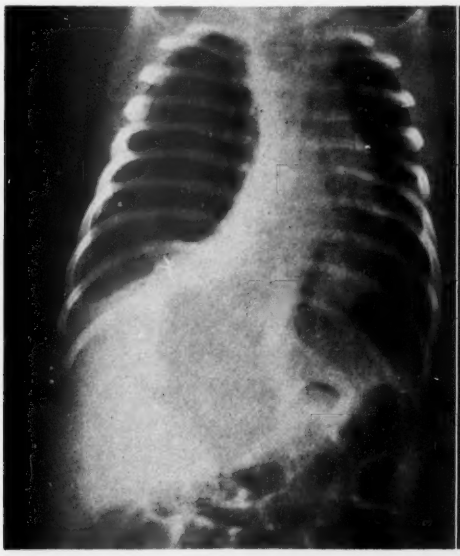

Fig. 4. *X*-ray of baby M. K. on admission. Note large amount of air and total collapse of lung with the presence of fluid, and extreme degree of mediastinal shift.

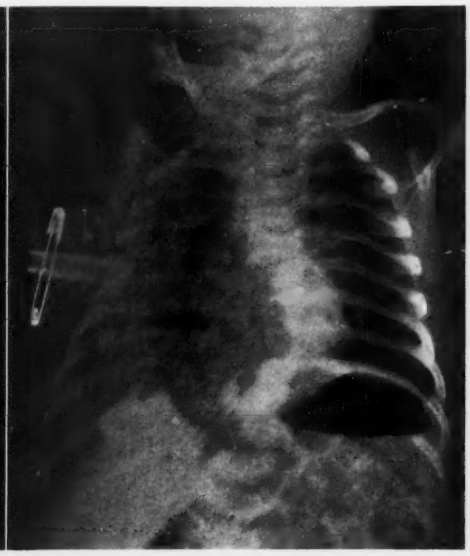

Fig. 5. *X*-ray of baby M. K. eleven days after rib resection had been done at the time of conversion to open drainage from closed drainage with constant suction.

It was believed that this area represented one of three things: a pulmonary cyst, a persistent pulmonary abscess, or a loculated empyema.

He was readmitted on March 3, 1943, eleven days after discharge, with a slight cough and a temperature of 101°F. (rectal), white blood cells, 17,900 with 73 per cent polymorphonuclears and *x*-ray revealed persistence of the cyst. Aspiration of a few drops of fluid and several cc. of air from previously mentioned cyst-like area was followed by immediate relief of fever, cough, and leucocytosis. His course was normal for four days when he was again discharged. No further symptoms occurred in eighteen months of follow-up. X-ray check-up on January 14, 1944, revealed no abnormality. On July 26, 1944, he was entirely normal in every way. (Fig. 3.)

Case II. M. K., a white male, age three weeks, referred by Dr. Norman Kendall, was admitted on March 31, 1944, because of grunting rapid respirations and cyanosis.

The baby had been born three weeks previously in Temple University Hospital after a normal uneventful delivery. It was perfectly well until March 29th when it seemed restless and fretful. On March 30th rapid respirations were noted with fever. The infant seemed much worse on March 31st when it was admitted to Temple University Hospital.

Physical examination revealed definite dyspnea and cyanosis. Temperature was 103°F., pulse 120, respirations 55. Examination was normal except for the chest. Expansion was markedly diminished on the right; breath sounds were markedly diminished on the right and exaggerated on the left. Moderate dullness to percussion was noted on the right. No râles were present.

*X*-ray showed complete collapse of the right lung with marked shift of mediastinum to the left and the presence of fluid and air. Aspiration revealed creamy pus and air under positive pressure. The white blood count was 23,200 with 54 per cent polymorphonuclears, all immature.

A rib resection was done immediately under local anesthesia, removing about 2 cm. of the right fifth rib in the mid-axillary line, and a mushroom catheter was inserted for *closed* drainage with constant suction of 2″ of vacuum by motor driven pump.

Culture taken on admission showed pure culture of non-hemolytic staphylococcus aureus, pathogenic strain (aerobic and anaerobic culture). This organism was also found in cultures from the nose and throat on that date and from a blood culture taken April 1st. On that day, after culture had been reported,

penicillin was begun and continued as follows: 1 cc. every four hours into drainage tube which was clamped for the next two hours. This was

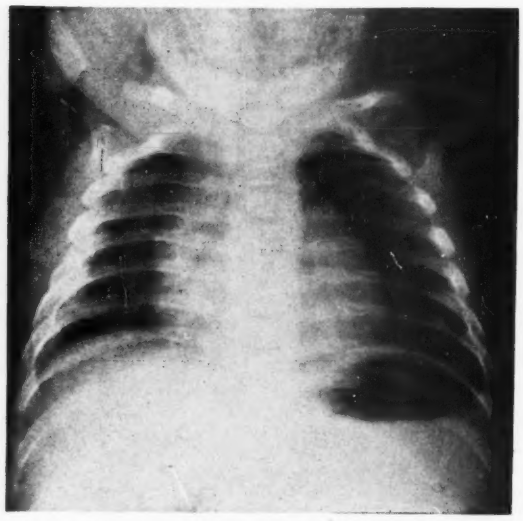

Fig. 6. *X*-ray of baby M. K. one month after discharge showing normal chest. (*X*-rays taken by Dr. W. Edward Chamberlain, Temple University Hospital, Philadelphia, Pa.)

continued for eleven days. One cc. intramuscularly every three hours was given for eighteen days, when the dose was changed to 2 cc. intramuscularly every two hours and continued for seven days.

Three days after closed drainage was instituted the condition was much improved with a fall in the respiratory rate and loss of cyanosis. Four days after drainage the temperature reached normal although positive cultures of the staphlococcus were still being obtained from the drainage. One week after drainage the baby was doing very well despite the fact that Bacillus pyocyaneus was found on cultures from the drainage tube. On April 11th, or eleven days after drainage, conversion to open drainage was instituted. Two weeks after drainage. despite the fact that the temperature was normal and the baby looked very well, a few Staphylococcus aureus were found in the culture. All subsequent blood cultures were negative and the baby was gaining weight in a normal fashion. On May 3rd, twenty-nine days after admission the child was discharged, after having had a normal temperature for two weeks. The drainage tube had been entirely removed four days previously and the last culture from the incision showed a few Bacillus pyocyaneus.

Between the period from April 11th to April 20th the child gained 1 pound 8 ounces.

In addition to the penicillin, other therapy consisted of 70 cc. blood transfusion on April 18th and 60 cc. the following day. These were given because of anemia. Also vitamins were given and adequate feedings were maintained by mouth. Oxygen was used for the first two weeks as needed.

At no time did the baby appear extremely ill after drainage was instituted. *X*-rays taken every week in the hospital showed steady expansion of lung and clearing of pneumonitis.

On May 18, 1944, the baby was in excellent condition and the external drainage wound was entirely healed. *X*-rays of chest were taken for check-up and revealed an entirely normal chest.

## COMMENTS

It may be noted in these case histories that the most striking clinical feature was the rapidly progressive dyspnea. This was due to pressure pneumothorax which had not only caused complete collapse of the lung on the involved side but was also interfering with aeration of the opposite side, the result of mediastinal shift. Thus it was necessary to institute immediately some form of adequate closed drainage so that physiological pulmonary function could be restored.

In Case 1, the child was in extremis on admission. Immediate intercostal closed tube drainage with suction was done in the room as a life-saving measure. Adequate drainage could not be maintained by this method due to the narrowness of the interspaces, and it was necessary to do rib resection later.

Baby M. K. was treated by immediate rib resection with closed drainage and constant suction. Adequate drainage was maintained and we consider this later method as preferable. Naturally, open drainage which has been widely advocated as the treatment of empyema in children, was not to be considered in these cases due to lack of loculation or fixation of mediastinal structures.[1,9,10]

Baby R. S. received sulfa drugs by mouth. The cavity was obliterated entirely

and the drainage tube was removed in sixteen days.

Baby M. K. received penicillin locally and intramuscularly. The drainage tube was removed in twenty-nine days. This child had a positive blood culture on two occasions. We might attribute the prolongation to Bacillus pyocyaneus as a local bacteriological complication decreasing effectiveness of penicillin.

The reason for pyopneumothorax in both of these cases can be given only by supposition. We are inclined to believe that the only logical explanation is the sequence of a staphlococcic pulmonary infection with abscess formation and perforation into the pleural cavity. The possibilities of congenital areas of localized emphysema or small pulmonary cyst with rupture into the pleural cavity cannot be definitely ruled out.

## COMMENT

1. Pyopneumothorax in infants is less frequent but much more serious than the usual empyema in children.

2. Two such cases occurring in the first month of life are presented in which immediate closed drainage was a life-saving procedure. Both infants are now in excellent health.

3. We believe the etiology of the condition to be staphlococcic pulmonary infection with abscess formation and perforation into the pleural cavity.

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# INTRACTABLE PEPTIC ULCER

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OSHKOSH, WISCONSIN

IMMEDIATE results in attempts to evaluate various treatments of peptic ulcer may be deceiving because of the spontaneous remissions that characterize the disease. Remote results, preferably after ten years, must be studied before one may speak with any degree of confidence regarding the value of a certain type of treatment.

This contribution is a follow-up of a case reported in 1938[3,4] a summary of which follows:

In 1927, the first operation, (at seventeen years of age) consisting of appendectomy and gastroenterostomy for duodenal ulcer was performed. He was symptom free for five years. In 1932, he had an acute massive hemetemesis. The second operation, degastroenterostomy, excision of jejunal ulcer and new gastroenterostomy were performed. He was relieved of symptoms for two years. In 1934, he had another acute massive hemetemesis. A third operation, entero-enterostomy was performed with no relief of symptoms. In 1937, he had another massive hemetemesis. His ulcer symptoms continued. He consulted the author for the first time in 1938.

Diagnosis of jejunal (stomal) ulcer was confirmed by *x*-ray. On September 4, 1938 fourth operation was performed by the author. Excision of jejunal (stomal) ulcer with proximal partial gastrectomy (fundusectomy) was performed. His convalescence was prompt and there was marked improvement with a gain of twenty-one pounds' weight in four months.

The symptom free interval lasted until April, 1939, when an attack of flu was followed by another acute massive hemetemesis, but with very few gastric symptoms. In May, he had a severe dermatitis of undetermined origin. During the summer he was practically symptom free. In October, gastric symptoms returned, obstructive in type, with nausea, vomiting and gas. There was no hemetemesis. A test meal showed hydrochloric acid present 16, 24, 26 and 30 per cent.

On November 20, 1939, a fifth operation revealed a large ulcer one inch in diameter at the pylorus, buried in firm adhesions. (This ulcer was probably present at the time of the removal of the stomal ulcer in 1938.) Resection of the ulcer with gastroduodenostomy was performed. The gallbladder was adherent to the stomach and contained no calculi, but was drained. Convalescence was satisfactory with discharge from the hospital on January 12, 1940, with a gain of eight pounds in weight. There was gradual improvement and a symptom free period lasted until June 6, 1943, when he met with an indirect, accidental abdominal strain which was followed by pain, swelling, tenderness and impulse on coughing in the scar of previous operations. The acute swelling soon subsided, but localized induration, tenderness and rigidity, with constant gastric symptoms, persisted. A test meal showed hydrochloric acid not present in fasting stomach contents; post meal it was present 32, 33, 36, 20 per cent. *X*-ray showed "a filling defect at the pyloris."

Despite "medical management" symptoms persisted and on January 20, 1944, a sixth operation was carried out: The proximal stomach was small and adherent to the spleen, colon and diaphragm. The distal stomach, duodenum, colon and omentum were in a mass four inches in diameter and adherent to the liver and anterior abdominal wall. Exploration of this mass revealed a peptic ulcer one inch in diameter with a necrotic base and indurated margins. This ulcer was resected with a six inch triangle of proximal stomach and gastrointestinal continuity re-established by another atypica gastroduodenostomy. For the purpose of postoperative decompression and feeding a jejunostomy was performed. The ventral hernia was repaired in closing the abdominal incision.

His postoperative course was very satisfactory until the jejunostomy tube was removed on the tenth postoperative day, after which gastric obstruction necessitated on February 12, 1944, a seventh operation which was a rapid anterior gastrojejunostomy. Because of the many adhesions, the only suitable stomach was located very high near the diaphragm which called for a long loop of jejunum. This is, of course, not a desirable location for a gastrojejunal stoma, especially so in an individual with a history of intractable peptic ulcer, but no other procedure seemed practical under the circumstances and the local condition.

His postoperative course to date (April 9, 1945) has been satisfactory. The patient has gained weight, is comfortable and without "stomach distress or pains."

The final result is, of course, unknown and the prognosis must be guarded, but this case would seem to emphasize the advisability of removing a substantial amount of the acid secreting proximal stomach in recurrent or intractable peptic ulcer cases, which might be likened to the necessity of subtotal thyroidectomy in hyperthyroidism. It should be remembered that any type of surgical treatment is but an incident, often a most important incident, between preoperative and postoperative management.

In the treatment of peptic ulcer, the pendulum of opinion has swung from non-operative to operative and now again to non-operative as duodenal ulcer is considered to be a general disease with a local lesion, usually amenable to non-surgical management; except with complications: perforations, organic obstruction (perhaps hemorrhage under certain circumstances) and intractability.

In the surgical treatment, gastroenterostomies and pyloroplastics have been superceded by resections, first local excision of the ulcer, then pylorectomy, then resection of the "ulcer bearing area," then partial gastrectomy and at present this shift to the left has extended to subtotal gastrectomy, the presently accepted surgical treatment of peptic ulcer.

This procedure is objectionable in that it is mutilating, it sacrifices the important pyloric sphincter mechanism and the protective alkaline mucous secreting distal stomach.

It is based upon two fundamental objectives (1) minimizing the acid secreting fundal mucosa and (2) removing the antral mucosa. The former is a generally accepted principle of surgical treatment and will probably remain so until a remedial or removable cause of the hyperchlorhydria is discovered, or until a clinically applicable antisecretagogue is developed.

The latter is based upon "Edkin's Theory" that the antral mucosa secrets a hormone "gastrin" that stimulates secretion of hydrochloric acid in the fundus. This concept has not been proved, either experimentally or clinically and confusion exists between gastrin and histamine.[2,5]

Pylorectomy and antrumectomy, in which antral mucosa is removed, have not always been satisfactory.

Granting the existence of "gastrin" as an acid secretory stimulant removal of its source, the antral glands, may be compensated for by the Brunner's glands of the duodenum which differ from the antral glands chiefly in the relationship to the submucosa. Without such compensation other stimuli, i.e., psychic, gastric mechanical, and intestinal, may maintain hypersecretion, it would therefore seem that the possible advantage of removing the antral mucous membrane is of questionable value and would be more than offset by the mutilation in loss of sphincter action and alkaline secretion.

In 1929, the writer[6] suggested a modified type of resection which retained the desirable features and obviated the above objections to subtotal gastrectomy in treatment of non-obstructing duodenal ulcer.

The last word in treatment of intractable, or complicated peptic ulcer has probably not been spoken. That a trend in the direction of less extensive operations may be developing is to be seen in the studies of Heuer and Holman,[7] who state there are

probably other factors than the diminution of hydrochloric acid to account for the satisfactory results that often follow mutilating operations. (On the other hand it must be remembered that in the absence of hydrochloric acid, *peptic* ulcer does not occur.)

Andrus, Lord and Stefko[1] report favorable experimental and clinical results following a new surgical procedure in which a jejunal flap is transplanted into the stomach wall.

The numerous surgical attempts to reduce gastric acidity are, of course, merely symptomatic and not radical treatment. The exciting cause of the hyperacidity, probably a variable non-constant factor, unfortunately as yet unknown, may remain active.

Recently attention has been given to the neurogenic etiology of peptic ulcer; but division of the vagus with consequent sympathetic preponderance has not been followed by satisfactory results.[8,9] On the other hand one finds in the voluminous literature little mention of increased peptic ulcer symptoms after sympathectomy.

Medical management, non-operative treatment, has also passed through many changes that included practically all possibilities and many impossibilities.

Dietotherapy has shifted through all gradations from feeding (Lenhartz), empty stomach and light diet (Sippy) and back to feeding (Meulengracht).

The antacid soda treatment has still a very large following (as is also true of all symptomatic treatments), but there seems to be a definite trend away from neutralization and toward hydrochloric acid binding chemical substances and a definite increase in the popularity of less medication, except for sedatives or antispasmodics, with frequent small feedings, balanced rest and exercise, and emotional and environmental controls.

The final perfect ideal treatment will probably be non-operative medical management which must await development of a clinically applicable antisecretagogue, similar to the "entrogastrone" or "urogastrone" of Ivy.[10]

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# LYMPHANGIOMA OF THE ABDOMEN

## AN UNUSUAL CASE

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A LYMPHANGIOMA is generally described as a tumor composed of lymph vessels and spaces containing lymph. It consists of the endothelial cells and the supporting tissue elements of the lymphatic system which are involved in a neoplastic process.

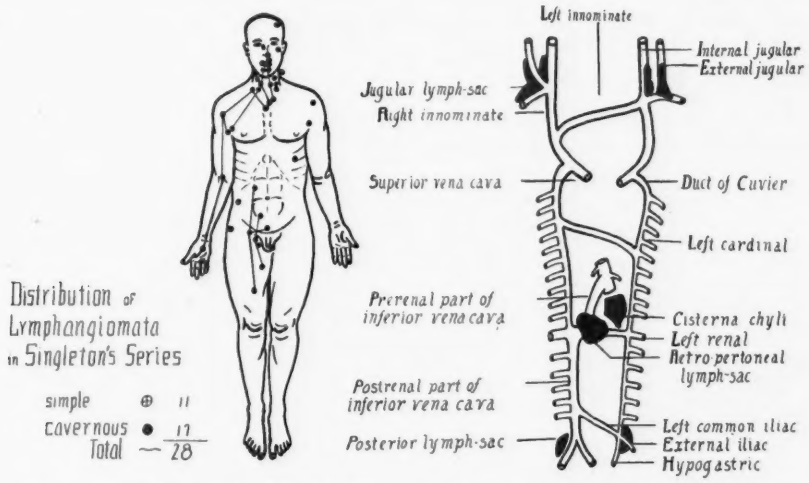


FIG. 1. The diagram on the left illustrates the distribution of lymphangiomas in Singleton's series (after Singleton); the diagram on the right, the distribution of the lymph sacs in the embryo (Gray's Anatomy after Sabin).

The lymphangiomas include a variety of slow-growing, usually congenital, single or multiple tumors involving chiefly the skin, subcutaneous and deep areolar tissues of the lips, tongue, neck, mediastinum, axilla, mesentery, omentum, retroperitoneal or sacral regions. Wegner's[2] original classification of lymphangiomas as simple, cavernous and cystic is commonly accepted. Watson and McCarthy[3] have added two divisions to this classification: cellular or hypertrophic lymphangioma and diffuse systemic lymphangioma, which appear to be sub-groups of the cavernous type.

It was apparent from the survey of the literature that there is still considerable confusion and lack of uniformity in the nomenclature and diagnoses of the lymphatic neoplasms. Even in the case report to be presented several diagnoses were ventured among a group of prominent pathologists from several medical colleges.

The great majority of the abdominal lymphangiomas reported in the literature have involved the omentum. About eighty-seven such cases have been reported.[3,5] All of these have been of the cystic type—unilocular or multilocular. Occasionally they have attained a considerable size, the largest reported weighing seventy-five pounds.[4] Most of them were discovered prior to adolescence but in several in-

stances they had gone unnoticed until middle age. The sex incidence was about equal. A correct diagnosis was seldom made prior to operation. The operative mortality

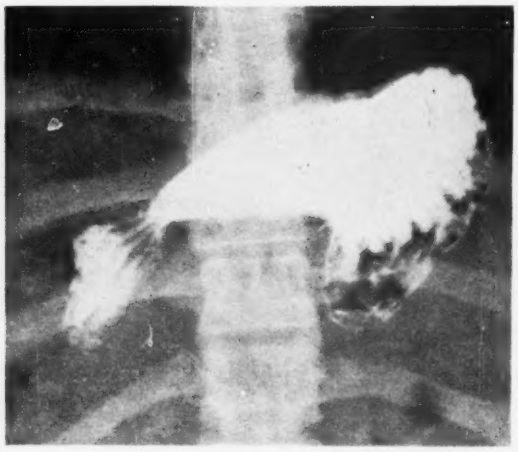

FIG. 2. Preoperative roentgenogram of stomach showing large filling defect of greater curvature and downward sweep of pylorus and duodenal cap.

was very low. These tumors are considered as being essentially benign and do not tend to recur if completely removed.

The retroperitoneal and mesenteric lymphangiomas appear to have occurred much less frequently. About ten cases have been reported in the literature.[6,7] All of these have been of the cystic variety excepting one which was of the cavernous type and resembled the one to be described in the case report to follow. The tumors in this region may be a mixture of the cavernous and cystic types. The retroperitoneal types originate along either side of the spinal column and frequently extend posterior to the colon, downward into the pelvis, upward toward the liver or anteriorly into the mesentery or the omentum.

Several theories have been advanced to explain the etiology of lymphangiomas, the more plausible one being the embryonal one. According to this theory these tumors arise from small segments of lymph tissue retaining their embryonal characteristics locally. The fact that lymphangiomas occur more frequently near the primitive centers of origin (Fig. 1) and are more common clinically in children lends considerable support to this theory. The fact that they are slow growing and benign may explain why they may go unnoticed until adult life.

FIG. 3. Preoperative position of small bowel, showing marked distortion and displacement of entire small bowel into right upper quadrant.

## CASE REPORT

The patient, a white male, aged thirty-five years, an officer in the Armed Forces, entered the Station Hospital on January 4, 1944. The chief complaint at the time of admission was a dull aching pain in the left upper quadrant which had been present since December 19, 1943. On the evening of that date this officer was returning home in a jeep after a day of very strenuous activity when he suddenly noted a sharp stabbing pain in his left hypochondrium. The patient felt that the pain was either the result of his arduous day's work (carrying goats) or caused by riding in a jeep over rough terrain for fifty miles. Despite the pain he rested well that night and was told by the attending medical officer to remain in his quarters on the following day. The abdominal distress became dull in character, no radiation was noted and the patient was free of any gastrointestinal signs or symptoms. On December 21,

1943, because of persistent pain, he was first admitted to another hospital. A diagnosis of hemorrhage into the abdominal wall was made and decidedly protuberant abdomen in which a firm mass could be felt in the left upper quadrant. The mass was smooth and its margins

Fig. 4. Preoperative roentgenogram showing filling defect and displacement of descending colon.

Fig. 5. Preoperative excretory urogram showing marked medial curve of the left ureter and downward displacement of the left kidney.

and the patient was discharged to light duty in three days. However, the pain continued and seemed to be aggravated by walking, bending, and laughing. On January 4, 1944, this officer returned to his regular military post and was admitted to this hospital for further study and treatment.

A careful history failed to elicit any abnormal gastrointestinal or genitourinary signs or symptoms. The patient had an excellent appetite and had gained weight recently. Since 1935, he had noted a very gradual increase in weight and abdominal girth. While undergoing army basic training in 1942, the patient lost fourty-five pounds. Some of this he regained subsequently and during the past ten months had gained twenty pounds. His waist measurement had increased about four inches during this time. His past general health otherwise had been remarkably good and he had passed several rigid physical examinations while in the army. The family history was non-contributory.

The general appearance of the patient was that of a well developed and well nourished white male who was apparently in excellent health.

Physical examination revealed a symmetrical were difficult to outline; however, it was considered to be about the size of a large grapefruit. A small area of tenderness was present where the mass extended beneath the left costal margin. Dullness was noted over the entire abdomen and the presence of ascites was considered likely. The mass did not move with the respiratory excursion and the abdominal viscera could not be palpated. Rectal examination was negative. His weight was 181 pounds and the remainder of the examination revealed nothing positive.

Laboratory studies were repeatedly found to be normal. A complete hematological survey including blood counts, smears, serological and immunological reactions, bleeding and clotting time, sedimentation rate and blood chemistry studies, was made and all examinations were reported as normal. Urinalyses, stool examinations and a tuberculin test gave negative results.

Roentgenographic studies, however, were extremely intersting. Examination of the upper gastrointestinal tract revealed an elevation and partial inversion of the stomach. (Fig. 2.) The greater curvature was deformed

by a large, smooth, rectangular, filling defect produced by an extrinsic mass. The duodenal sweep presented a J-shaped configuration

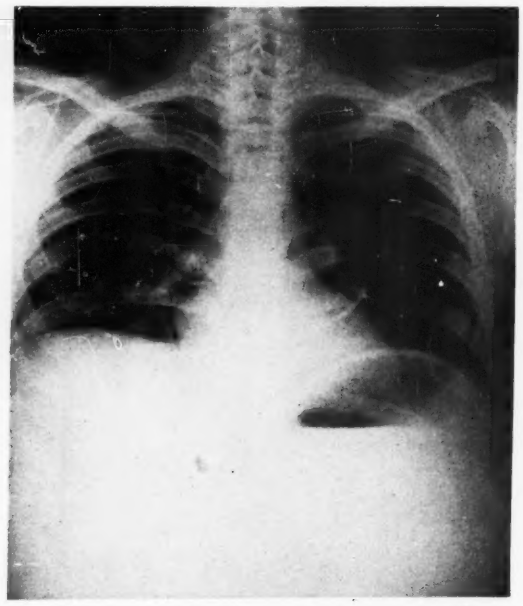

Fig. 6. Preoperative chest roentgenogram showing elevated diaphragm and atelectatic band in left lung field probably the result of compression.

instead of the normal C-shaped appearance. (Fig. 3.) The distal part of the duodenum and all of the jejunal loops were displaced into the right upper quadrant. The appearance of the stomach and loops of small bowel suggested a congenital anomaly,—failure of rotation of the small bowel.

A barium enema revealed the entire descending colon to be pushed toward the midline. (Fig. 4.) A crescent-shaped filling defect on the lateral aspect of the descending colon suggested pressure by an extrinsic tumor. Intravenous pyelograms clearly indicated that the left kidney was lower than the right and the left ureter was displaced toward the midline in a rather precipitous curve (Fig. 5). Examination of the chest revealed an elevated diaphragm, the left dome being almost as high as the right. (Fig. 6.) A rather dense, band-like oblique shadow was noted in the left lung field extending to the lateral chest wall. This was considered either a thickened interlobar fissure or a focal area of atelectasis as a result of restricted motion of the diaphragm due to increased intra-abdominal pressure.

On January 27, 1944, an exploratory laparotomy was performed through an extended left upper rectus incision. The peritoneum was opened and several hundred cc. of clear free fluid were aspirated. Immediately beneath the peritoneum there was an enormous encapsulated gelatinous tumor which was found to extend into every part of the peritoneal cavity from the pelvis to the diaphragm. The tumor was soft, jelly-like and a mottled grayish red in color. (Figs. 7 and 8.) A film of delicate adhesions connected it with the parietal peritoneum and viscera. The tumor was carefully mobilized and delivered, not without difficulty, onto the abdominal wall. The pedicle was relatively small and found to arise at the root of the mesentery where it was cut between double ligatures. The tumor weighed eighteen and one-half pounds.

The entire small bowel had been compressed posteriorly just below the liver, and the many loops of gut, being imprisoned in the right upper quadrant, had produced traction on the base of the mesentery. The abdominal viscera otherwise appeared to be quite normal. There were no metastases noted in the liver or elsewhere in the peritoneal cavity.

The patient was given 500 cc. of whole blood and 500 cc. of plasma while in the operating room and he was returned to the ward in good condition. The type of anesthesia was gas-oxygen-ether.

Following operation the patient made an uneventful recovery. On the fourteenth postoperative day he was again weighed and his abdominal girth measured. It was found that he had lost twenty-six pounds in weight and that his waistline was four and one-half inches smaller.

Roentgenographic studies were repeated during the patient's convalescence and it was noted that all of the viscera had once again assumed their normal positions and shape. The area of focal atelectasis had disappeared from the left lung field and the left dome of the diaphragm descended to its normal position. The small bowel had resumed its proper place and the stomach and duodenum were no longer deformed or displaced. Except for a small area of narrowing in the descending colon, the large bowel was normal. It was somewhat surprising to find that the left kidney and ureter had also returned to their normal positions. The left kidney was now higher than the right and the course of the left ureter was no longer curved.

The patient made an excellent postoperative recovery and was returned to duty in the Armed Forces. One year after the operation he was still free of symptoms and a G. I. *x*-ray series was found to be negative.

Fig. 7.

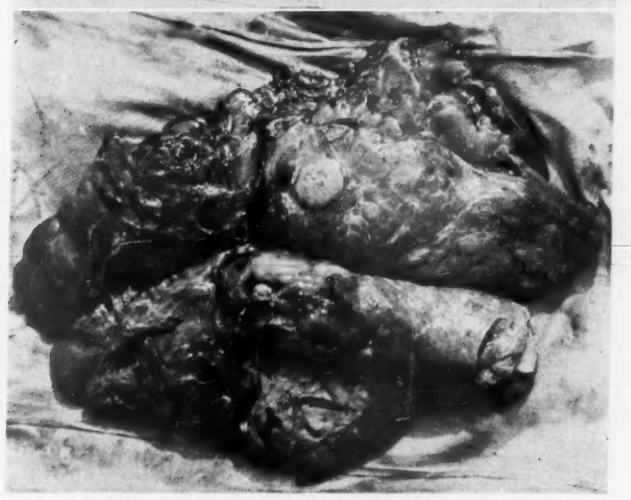

Fig. 8.

Fig. 7. Gross specimen of tumor. Measurements are 60 by 25 by 10 cm., weight eighteen and one-half pounds.
Fig. 8. Cut section of lymphangioma showing well circumscribed nodules.

The pathological report revealed the following: The tumor consisted of a large, elongated and somewhat conical, jelly-like mass, measuring 60 by 25 by 10 cm., and weighing eighteen and one-half pounds. It was covered with a thin, smooth, glistening, vascularized capsule through which the tumor appeared dark reddish-purple in color. On palpation firm nodular masses could be felt throughout the tumor.

On section the tumor appeared to be myxomatous in character with numerous firm, grayish-white, well circumscribed nodules distributed throughout the structure, varying in size from 2 to 10 cm. in diameter.

Microscopically, the myxomatoid, intervening tissue structure was made up of large vascular channels filled with granular eosinophilic material. These channels were lined with slightly flattened endothelial cells and were separated from one another by narrow well defined septa. The nodular areas were very cellular, consisting of fairly closely packed spindle or polyhedral cells. In some areas there was relatively little stromal structure; in others the cells were definitely laying down connective tissue fibrils. The transition between the nodular areas and the myxomatous structure was very abrupt. In all sections small channels lined by endothelial cells could be seen. In some sections there was definite anaplasia of the tumor cells, but mitotic figures were rare.

The diagnosis of this tumor rests in part upon the interpretation of the significance of the vascular channels, depending upon whether these dilated lymph vessels are considered to be an essential part of the tumor or an unusual dilatation of pre-existing lymphatics. The diagnoses of a number of pathologists to whom sections of this tumor were sent for study were,

with one exception, divided between the diagnosis of lymphangioma and that of fibromysosarcoma. Detailed study is convincing that, even in the more cellular areas, minute endothelial-lined channels are being formed by the tumor cells, and that there is, consequently, a definitely endotheliomatous component of the tumor. However, as shown by special stains, other tumor cells in the same areas were definitely of a fibroblastic nature as indicated by the formation of intercellular collagen fibrils. This would lead to the conclusion that the tumor is of mesenchymatous origin, differentiating along both endotheliomatous and fibroblastic lines and leading to a diagnosis of lymphangioma, or, because of the possibility of malignancy, lymphangiofibrosarcoma.

For the most part, this tumor appeared to be benign in character. The areas of cellular anaplasia indicated that there was some chance of recurrence.

## COMMENTS

Endothelial tissue tumors are not common and frequently are very difficult to classify. Of these ill defined tumors the lymphangiomas and particularly the solid cavernous or cellular type are *very* rare. A review of the literature failed to reveal a lymphangio-endothelioma combination similar to the case reported.

Endothelium lines cavities, and lymphangiomas show this lining of their lymph spaces, but these cells may also proliferate to form solid masses. Thus, it is often difficult to diagnose these tumors and a wide variance of opinion may be expressed by competent pathologists.

Microscopic sections and a gross description of the tumor herein reported were submitted for examination to ten leading pathologists both in the military service and at well known University clinics. These reports were noteworthy for their decided division of opinion between (1) lymphangioma and (2) fibromyxosarcoma. Perhaps this lack of uniformity is best understood by the chameleon-like properties of endothelial cells and the wide variety of tissue that may be included in a tumor of the lymphatic system. Although the demarcation between innocent and malignant tumors is not a hard and fast line it is believed that this lymphangioma is a relatively benign tumor which may recur locally only after some years.

Perhaps the most bizarre findings in this case were the roentgenograms. The preoperative studies of the gastrointestinal tract were so distorted by the slow-growing, space-occupying tumor that the roentgenologist's interpretation was that of a congenital anomaly, failure of rotation of the small bowel. The large filling defect of the greater curvature of the stomach produced a partial inversion of that organ. Despite the fact that in man the entire duodenum is firmly anchored in position by the fusion of the parietal and visceral peritoneum, as well as the suspensory muscle of Treitz, in this case the position of the duodenum was so displaced that its normal C-shape was reversed to form a J.

The well marked curvature of the left ureter as outlined by intravenous pyelograms was most likely due to traction on the root of the mesentery. Normally, the ureter follows an almost vertical course downward on the anterior surface of the psoas major muscle. However, in its bed of areolar tissue it is closely related to the posterior peritoneum, adjacent to the root of the mesentery, is crossed by the mesocolon and may be displaced by traction on any of these tissues.

The fact that this massive abdominal tumor could not be palpated except in the left upper quadrant may be explained by pointing out that except for well circumscribed hard nodules (one of which was in the left upper quadrant) the entire consistency of the tumor was jelly-like.

## SUMMARY

1. An unusual case of lymphangioma of the abdomen is reported. The tumor weighed eighteen and one-half pounds and measured 60 by 25 by 10 cm.

2. Attention is again focused on the relationship between the embryonal origin

of the lymphatic system and the sites of predilection for lymphangiomas.

3. The bizarre roentgenographic changes of the gastrointestinal and genitourinary tracts are carefully described.

4. The patient was operated upon, the tumor removed and following an uneventful recovery the officer was returned to military service.

The authors are indebted to R. L. Ferguson, M.D., Department of Pathology, Medical Research Laboratories, Edgewood Arsenal, Maryland, for his collaboration on the section pertaining to the pathology of this case report.

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There is no relation between the size of the tumor and metastases. Studies of lymph-nodes of the Gilchrist and David modification of the Spalteholtz method have shown that lymph-node involvement may be present even when the glands are not palpable. Also, those glands which are palpable may not be involved.

From "Metastases Medical and Surgical" by Malford W. Thewlis (Charlotte Medical Press).

# ACUTE PHLEGMONOUS CECITIS*

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IN 1943, Spivack and Busch[1] reviewed the literature and described two cases of primary phlegmonous cecitis, bringing the total number to thirty-seven. These authors divided the cases into two groups: the circumscribed and diffuse forms. They assumed that the disease starts as a suppurative process in the submucosa, terminating in one of the above two types. The organisms most commonly found were streptococci and staphylococci. Bacillus coli and pneumococci were also reported. The portal of entry for these organisms may be by the enterogenous or hematogenous route. The former may develop following abrasions of the mucosa as a result of foreign bodies, hard fecal material or worms in the lumen. The most common symptoms were those of elevated temperature, abdominal pain and vomiting. There was usually an elevation of the white blood cells, particularly the polymorphonuclear leukocytes. Physical examination in cases of phlegmonous cecitis disclosed a tender palpable mass in the right lower quadrant of the abdomen. The differential diagnosis from other surgical conditions in the right lower quadrant of the abdomen includes appendicitis, appendiceal abscess, tuberculosis of the cecum and regional ileitis involving the cecum. The presence of a tender tumor mass in the region of the cecum soon after the onset of symptoms is the best clue to a correct diagnosis. Treatment requires surgical exploration of the abdomen. A critical analysis of all cases by Spivack and Busch[1] suggests that for the localized form of the disease no further surgery should be done (although appendectomy was performed by many previous investigators). The diffuse type, however, requires an ileocecal resection.

Since 1943, there have been no other cases of primary phlegmonous cecitis reported. The following patient came under the observation of the present authors:

## CASE REPORT

W. F., a white adult male, age thirty-five years, was admitted to the South Nassau Communities Hospital on May 27, 1943. His chief complaints were pain and tenderness in the right lower quadrant of the abdomen of twelve hours' duration. The patient stated that for about twelve hours prior to the onset of the pain, he suffered mild distress in the epigastrium which radiated down to and localized in the lower right quadrant. The past history was entirely negative. Family history disclosed that two brothers were "bleeders."

Physical examination revealed nothing positive, except for the presence of a tender, palpable mass in the lower right quadrant in the region of McBurney's point. Urinalysis was entirely normal. The blood count on admission showed: hemoglobin 13.9 Gm., red blood cells 4,700,000, white blood cells 10,000, of which there were 75 per cent segmented neutrophiles, 21 per cent lymphocytes, and 4 per cent monocytes. Temperature on admission was 99.6°F., pulse 106, respirations 20. A diagnosis of acute appendicitis was made and the patient was operated upon shortly after admission.

Under a general anesthetic a right rectus incision was made. The appendix was located and found to be injected but was obviously not the cause of the severe localized pain experienced by the patient preoperatively. Further exploration revealed a large, acutely inflamed mass in the cecum 4 cm. in diameter. The cecum was freely movable and was delivered into the abdominal wound without difficulty. It was dark red in color and along its medial aspect several large pink nodes were present. One of these nodes was excised for microscopic examination. The epiploic fat in

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the vicinity of the cecum was also dark red. Some of this tissue and the appendix were removed. The cecum was replaced and the wound closed in layers.

On the third postoperative day the temperature rose to 101°F., pulse 120, respirations 36. At this time the patient had abdominal pain. There was rigidity of the abdomen with rebound tenderness and distention. A diagnosis of spreading peritonitis was made. On the sixth day the temperature rose to 104°F., pulse 120 and respirations 30. On the seventh day sodium sulfathiazole was administered intravenously. The temperature gradually fell to a level of 100°F. The pulse remained elevated between 130 and 140 and the respirations were 20. On the tenth day a large, subcutaneous abscess in the line of incision was evacuated, and about 100 cc. of a foul serosanguineous, purulent exudate was obtained. This abscess was thought to communicate with the peritoneal cavity. The patient was given transfusions of whole blood and plasma but these failed to relieve the developing toxemia. He expired on the eleventh day after operation.

Microscopic examination of the appendix showed no acute inflammatory process. The mesenteric lymph node disclosed moderate hyperplasia of the follicles. The epiploic fat was congested and hemorrhagic.

At autopsy the positive findings were as follows: The abdomen appeared distended. A cigaret drain protruded from a right rectus operative wound in the abdomen. The heart showed extensive hemorrhage into the anterior wall of the pericardial sac. The heart was normal in size and weighed 300 Gm. There were no unusual changes found. The right pleural cavity contained about 400 cc. of a clear yellow fluid. About 200 cc. of a similar fluid were present on the left side. The lungs were lying free and had a combined weight of 1,600 Gm. The organs were grossly edematous but showed no evidence of pneumonia or other pathological processes. The trachea and bronchi were essentially normal. The peribronchial nodes were not enlarged. The abdominal cavity contained about 20 cc. of a thick, purulent fluid containing considerable fibrin, which was localized to the pelvis. In the right gutter there was some freshly clotted blood which weighed about 30 Gm. and measured 8 cm. in diameter. This clotted blood was lying along the right border of the cecum. Loops of the small intestines and omentum were adherent to each other and to the anterior wall of the abdomen by a fresh fibrinous exudate. Other portions of the small intestines were adherent to the parietal peritoneum in the pelvis. The surface of the cecum was covered by a thick green fibrinous exudate, which was mixed with fresh blood. Examination of stomach and small intestines showed no unusual changes. The cecum was dark red in color and the mucosa hemorrhagic. This hemorrhage appeared to extend through the entire thickness of the wall. The cecum was unusually large and presented the appearance of a large diverticulum. The appendix had previously been removed. The sutures at its base and mesentery were well tied and showed no evidence of leakage. In the mesentery of the small bowel there were several enlarged soft pink nodes and a moderate amount of fat. There was no gross evidence of thrombosis or embolization of any of the vessels leading to the cecum. No tumor masses were found in the terminal ileum, cecum or ascending colon. On the anterior surface of the cecum there were two cystic spaces in the wall, each measuring between 2 and 3 cm. in diameter. These cysts were filled with a thick, foul-smelling green pus, but did not communicate with either the lumen of the cecum or the peritoneal cavity. Bacillus coli was cultured from these abscesses.

There was no evidence of any obstruction to the outflow of stool from the rectum. The liver weighed 1,800 Gm. and was covered by a fibrinous purulent exudate. The parenchyma was light brown in color and appeared grossly fatty. There was no evidence of any metastasis or abscess formation. The portal vein was not thrombosed. The gallbladder was normal. The pancreas was also normal and weighed 30 Gm. The spleen weighed 400 Gm. The organ was enlarged and covered with a thick, fibropurulent exudate. The parenchyma was soft, friable and pultaceous. The adrenal glands showed no unusual changes. The kidneys had a combined weight of 500 Gm. The capsules stripped with ease. The cortex and medulla were of normal thickness and well differentiated. There was no increase in pelvic fat. The ureters were normal. The bladder contained 120 cc. of a clear yellow urine; the prostate was not enlarged. The external genitalia were normal. Microscopic examina-

tion of these organs showed complete necrosis of the wall of the cecum with diffuse leukocytic infiltration. The mucosa was entirely destroyed. Small subserous abscesses were present. The liver contained small miliary abscesses. The parenchymal cells disclosed marked cloudy swelling. The tubules of the kidneys showed a similar process. In the mesenteric and abdominal nodes the sinusoids were dilated and congested. The follicles were intact.

## COMMENT

The case presented was unusual in that it presented the picture at operation of a localized phlegmon of the cecum which progressed to the diffuse form, causing the death of the patient. In retrospect, one can state that the diagnosis of phlegmonous cecitis could have been made prior to operation because of the presence of a tender, palpable tumor mass in the right lower quadrant of the abdomen after a history of only twelve hours' duration. From the available data in our patient the authors are inclined to the theory that the enterogenous route of infection was the one which occurred in the case described. There was nothing to indicate a metastatic or hematogenous infection. The organism found at autopsy, namely, Bacillus coli, may not necessarily have been the one originally involved, and so should be discounted.

## CONCLUSIONS

1. A case of primary diffuse phlegmonous cecitis is presented.

2. The pathognomonic symptoms of pain and tender palpable mass in the right lower quadrant of the abdomen early in the disease are stressed.

## REFERENCE

1. Spivack, A. H. and Busch, I. Phlegmonous cecitis. *Am. J Surg.*, 61: 54, 1943.

# New Instruments

## A MODIFICATION OF THE NOSIK-GARDNER SUCTION IRRIGATOR

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NOSIK and Gardner designed a combined suction irrigator instrument which they reported in May, 1939.[1] By means of this one instrument it is possible to irrigate the wound, and then by shifting the thumb lever to suck the fluid away. As these men pointed out, it is imperative to have a clean field in neurosurgical procedure, and the usual method is to wash out with a bulb and syringe and then suck the saline away through cotton pledgets. By combining these two features, there is a saving of time, as one assistant can do the whole job. Another advantage is that the irrigating stream is smooth and even and can be easily regulated. In addition, the view is not obstructed by the air bubbles in the fluid, which are present when a bulb and syringe are used. The irrigating fluid is kept in a large reservoir which is covered. Its temperature can be better regulated and it is less likely to become contaminated than is the usual uncovered pan filled with saline. Blocking of the suction unit by blood and tissue can be prevented by frequently running saline through the instrument.

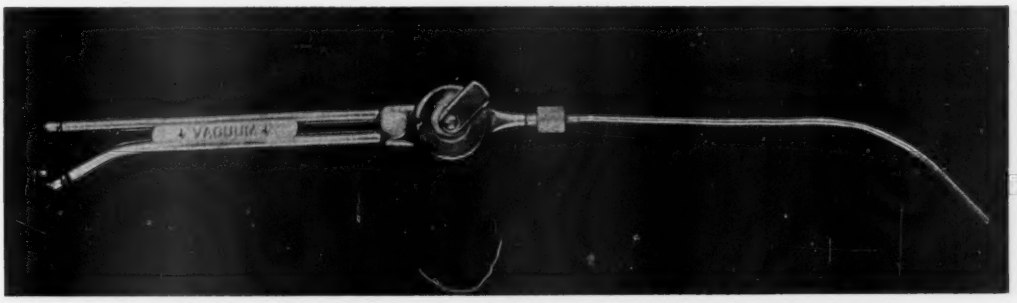

FIG. 1. This photograph shows the original Nosik-Gardner suction irrigator with the screw to which the cautery unit is attached just behind the thumb lever.

We were of the opinion that by adding a cauterizing unit to this instrument, it would be further improved. This was done by merely adding a screw to the side of the instrument, as is shown in Figure 1 and attaching the cautery wire to it.

By means of this three-way instrument, one man can irrigate the wound, dry it, and cauterize any bleeding points.

### REFERENCE

1. NOSIK, W. A. and GARDNER, W. J. A neurosurgical suction-irrigator. *Am. J. Surg.*, 44: 477–478, 1939.

# NEW CIRCUMCISION CLAMP

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NEW YORK, NEW YORK

ALTHOUGH a great majority of practitioners still prefer to use the time honored dorsal slit-trim-suture technic of circumcision, the popularity of the clamp method, be it a plain clamp, the Gomco, Lindsay clamp, or other modifications, warrants the attempt to devise an instrument which is simpler in construction and easier to manipulate.

The construction of this clamp is basically that of any ordinary hemostatic forceps. (Fig. 1.) The tip of the upper blade ends in a bell, tunnelled for the escape of urine, while the lower blade supports a ring in which the bell rests when the clamp is closed, as illustrated by cross-section in Figure 2.

Once the adhesions between the prepuce and the glans are separated, and in cases of extreme phimosis, the prepuce slit dorsally, the organ is passed through the ring at the lower blade of the clamp. The rim of the prepuce is then held with two mosquito clamps and the bell is introduced into the preputial cavity. (Fig. 3.) The prepuce is then spread evenly around the bell and the clamp is locked tight. The clamp is left in place for a minute or two over the patient's coagulation time, while the prepuce is trimmed off with a scalpel over the ring and against the bell. (Fig. 4.) The clamp is then unlocked and removed.

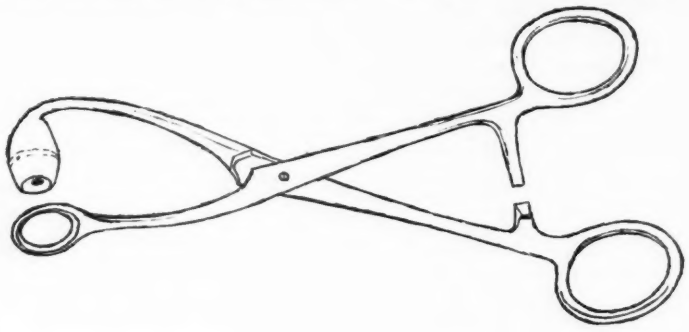

FIG. 1.

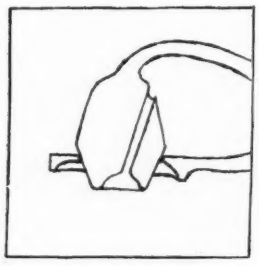

FIG. 2.

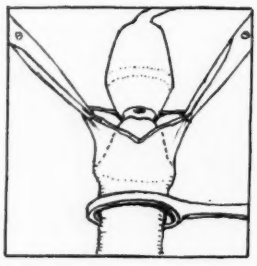

FIG. 3.

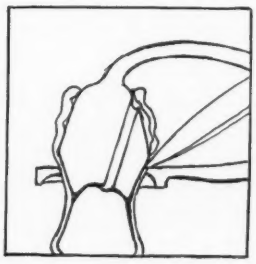

FIG. 4.

FIGS. 1 TO 4. 1, Circumcision clamp. 2, Cross-section of the tip of the clamp showing the bell and the ring. 3, Illustration showing the bell introduced into the preputial cavity. 4, Clamp locked and prepuce excised.

The advantage of this over clamps currently in use lies in the following: The clamp is in one piece and can be handled with one hand while the others are made of three separate pieces, and their use entails quite a bit of fumbling particularly in the hands of the occasional operator.

The withdrawal of this clamp after the completion of the operation, does not open up the freshly cut edge of the prepuce as do other clamps, and is, therefore, less prone to start bleeding.

I am indebted to Mr. Robert Issacsen of the Universal Stamping Corporation for helping me out with this clamp.

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NEW SERIES, VOLUME LXVIII

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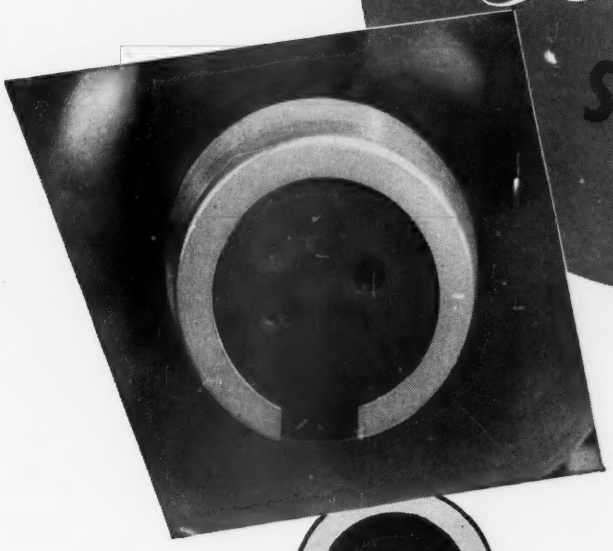

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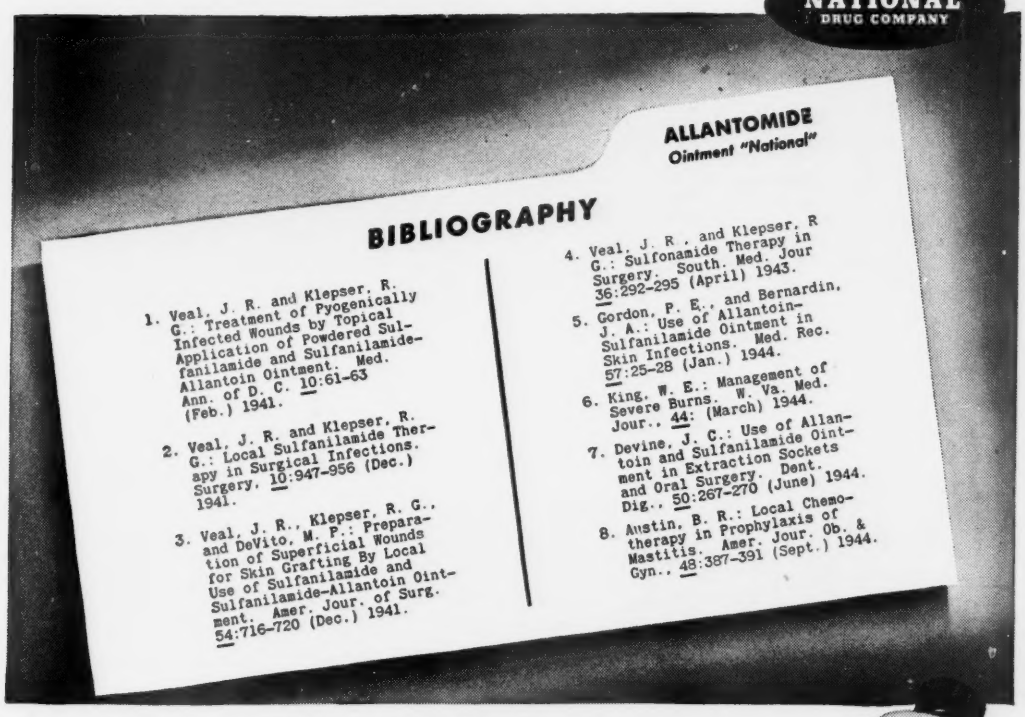
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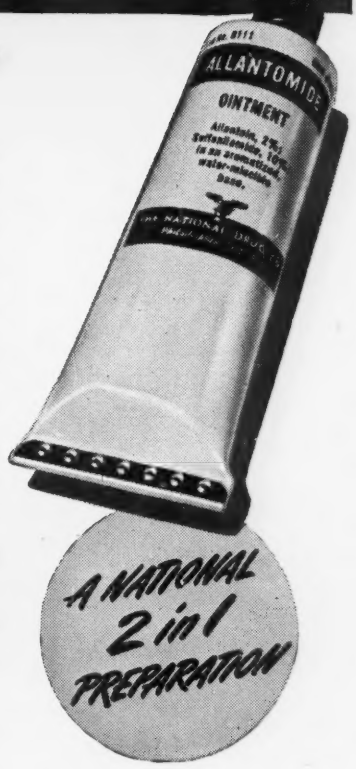


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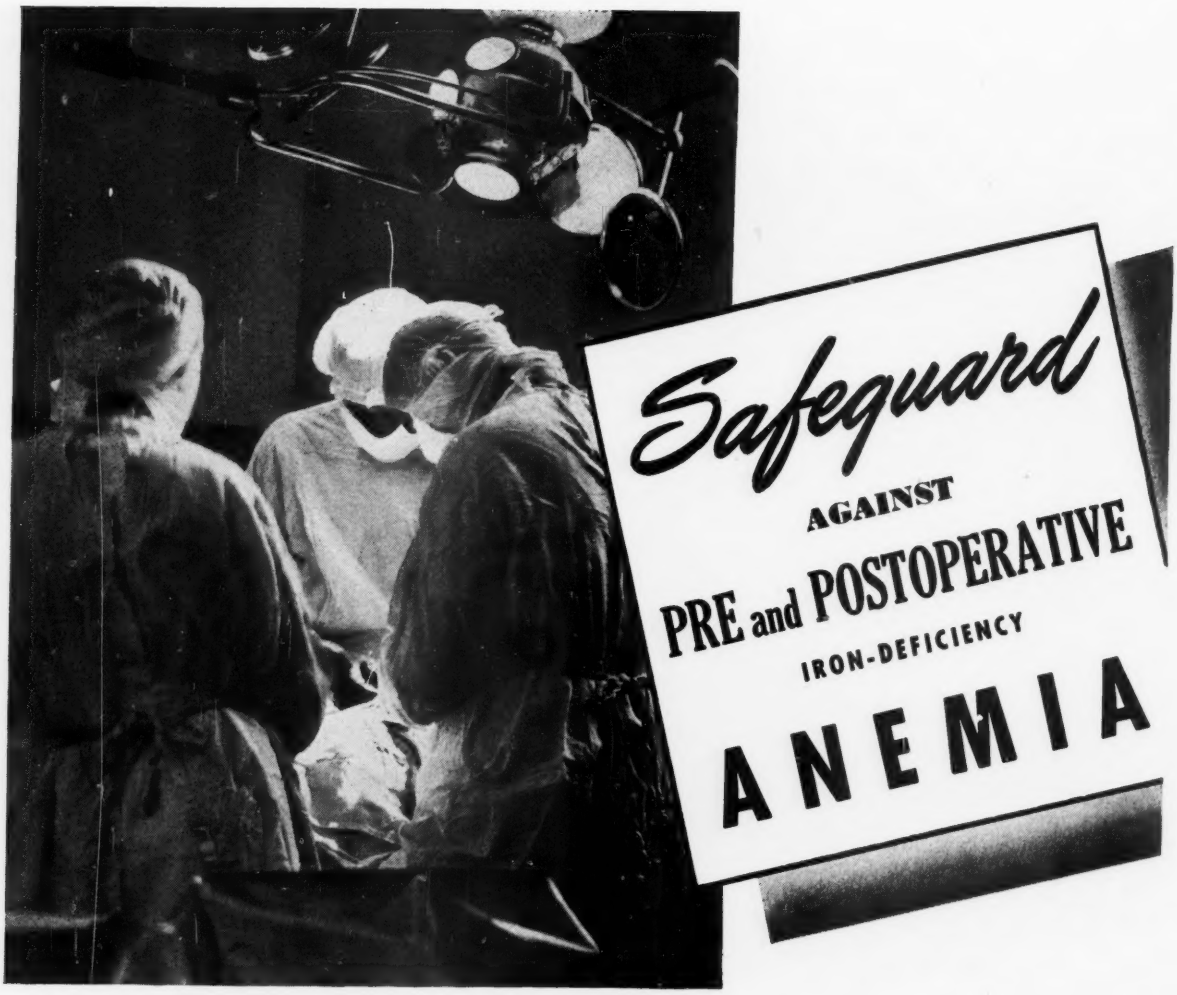

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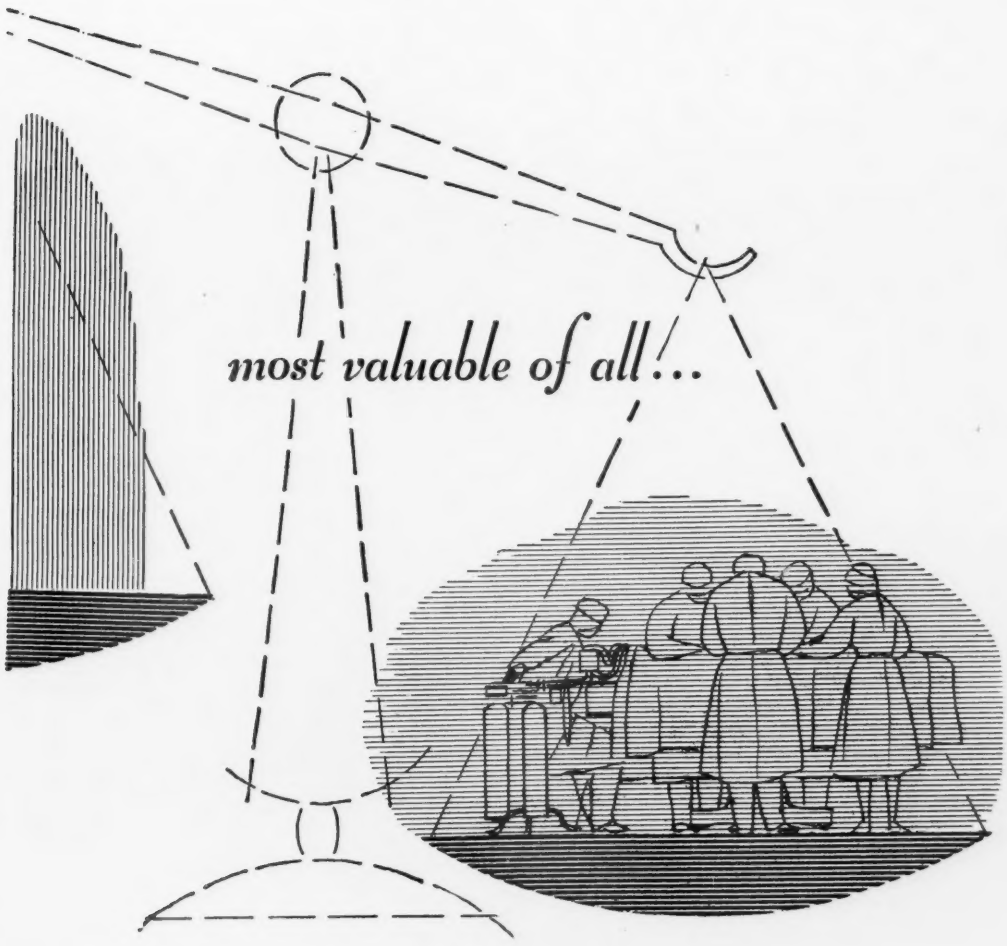


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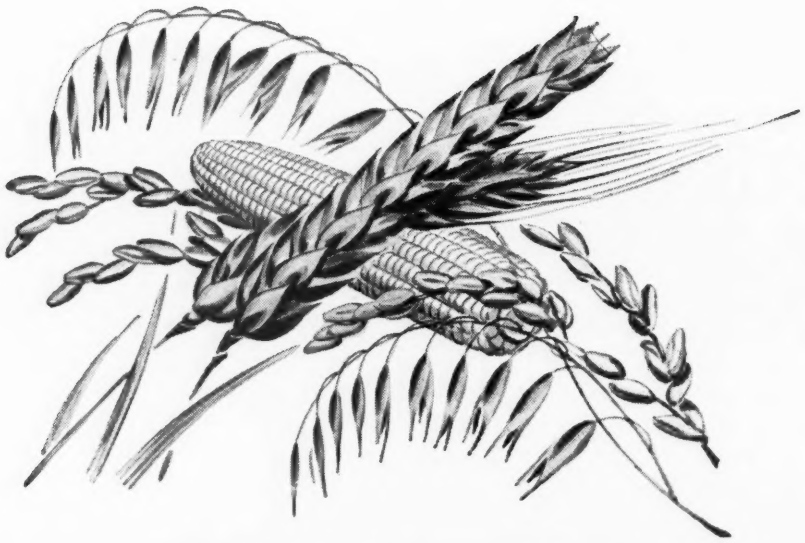

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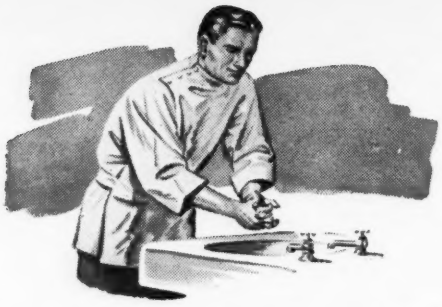

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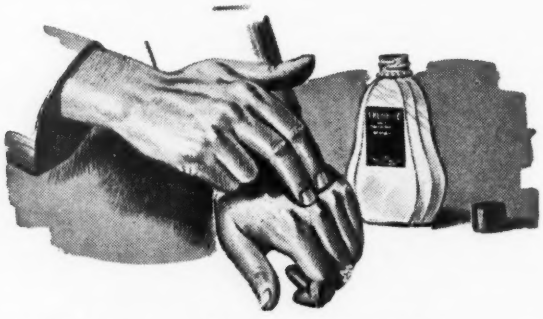

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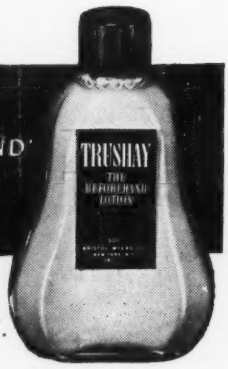


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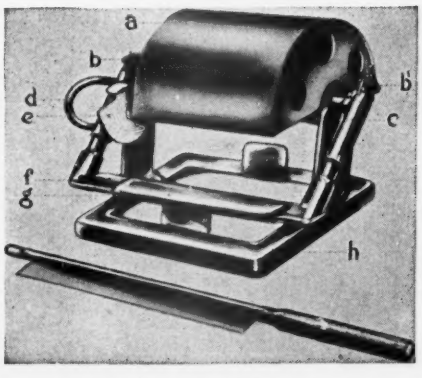


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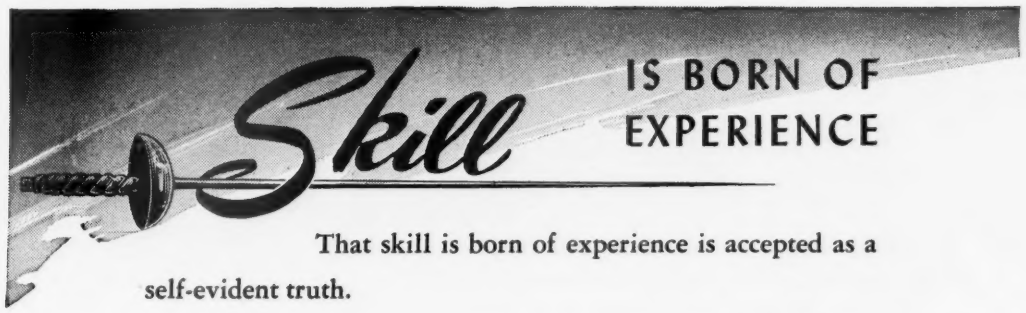


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SELF-STERILIZING

# Advantages OF SELF-STERILIZING NEO-SULFAREA IN THE TREATMENT OF SUPERFICIAL AND DEEP WOUNDS

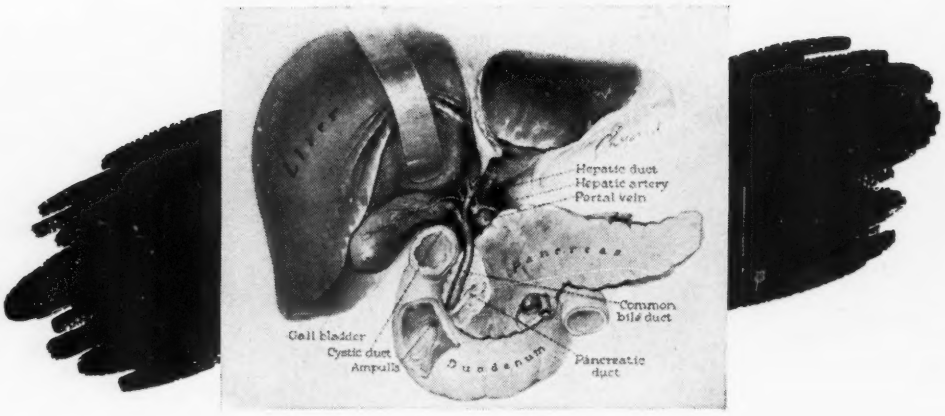
**INFECTED TRAUMATIC WOUNDS AND BURNS—LEG ULCERS—BED SORES**

NEO-SULFAREA—2% Micronized Sulfanilamide, 2% Micronized Sulfathiazole, 10% Urea in a new water soluble, vanishing cream base—offers decided clinical advantages:—

(a) The new self-sterilizing feature of Neo-Sulfarea makes it suited to the treatment of deep seated infected wounds.
(b) The sulfonamides have demonstrated their effectiveness against common pyogenic organisms.
(c) The presence of urea helps stimulate formation of granulation tissue and promotes healing.

*In ¾ oz. tubes and 1 lb. jars at better pharmacies.*

**THE DRUG PRODUCTS CO., INC.**
19 West 44th Street . New York 18, N. Y.




# New Clinical Studies in Hepato-Biliary Dysfunction

***In a careful clinical study of more than 500 patients, the authors* report . . . . .***

"SORPARIN was found to be most effective clinically with those patients suffering from liver disease, primary or secondary. The specific conditions included hepatitis with and without jaundice, chronic cholecystitis with and without stone, cirrhosis, post-surgical biliary states, diabetes mellitus, Banti's syndrome and chronic passive congestion of the liver . . .

"The extract (Sorparin) was shown to improve glucose tolerance . . . in hepatic disease." Dyspeptic symptoms were usually dispelled.

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" . . . no instances of toxicity . . . were found."

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(Ext. Sorbus aucuparia McNeil)

*Supplied in tablets each containing 3 gr. Sorparin. Bottles of 100, 500 and 1000.*

*DeLor, C. J. and Means, J. W.: Clinical Studies on the Berry of Sorbus Aucuparia, Rev. Gastroenterol., 11:319-327 (Sept.-Oct.) 1944.

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# Major surgery... severe infection... pregnancy

All the states and diseases which heighten metabolism, limit the diet or inhibit absorption of nutrients are known to be causes of sub-adequate nutrition. In such cases the surgeon or physician is well advised to combat the development of avitaminosis with

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Each small capsule provides substantial amounts of eight vitamins—presenting all clinically established vitamins in amounts safely above adult basic daily requirements, yet not wastefully in excess of the needs of the average patient for whom such multiple vitamin reinforcement is indicated. Herein lies its unique and impressive economy.

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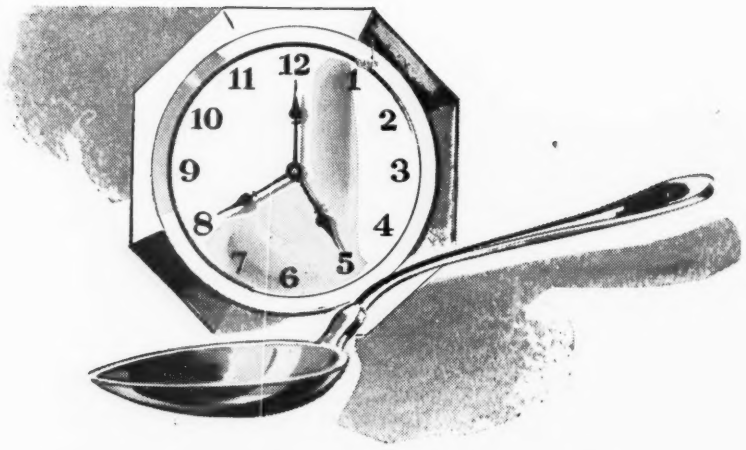
*White's* PRESCRIPTION *vitamins*



# A Valuable Routine Measure

Prescribed routinely before elective surgery, LIVITAMIN reduces operative risk by improving the ability of the patient to withstand anesthesia and surgery. Because LIVITAMIN is presented in liquid form, it may be administered early after surgery to overcome B vitamin and iron deficiencies if present, or guard against their occurrence. It aids in overcoming anorexia, speeds return to normal strength.

LIVITAMIN, notable for its palatability, and providing liver concentrate, readily utilized iron, and a rich store of B vitamins, will be found a valuable aid in hastening postsurgical recovery.

## LIVITAMIN

*Each fluidounce of Livitamin presents:*

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| Fresh Liver (as Liver Concentrate) | 2 oz. |
| Thiamine Hydrochloride ($B_1$) | 3 mg. |
| Riboflavin ($B_2$, G) | 1 mg. |
| Nicotinamide (Niacinamide) | 25 mg. |
| Pyridoxine Hydrochloride ($B_6$) | 1 mg. |
| Pantothenic Acid | 5 mg. |
| Iron and Manganese Peptonized | 30 gr. |

Contains the vitamin B complex factors naturally occurring in liver and rice bran, fortified with synthetic $B_1$, niacinamide, $B_2$, $B_6$, pantothenic acid and with iron and manganese.

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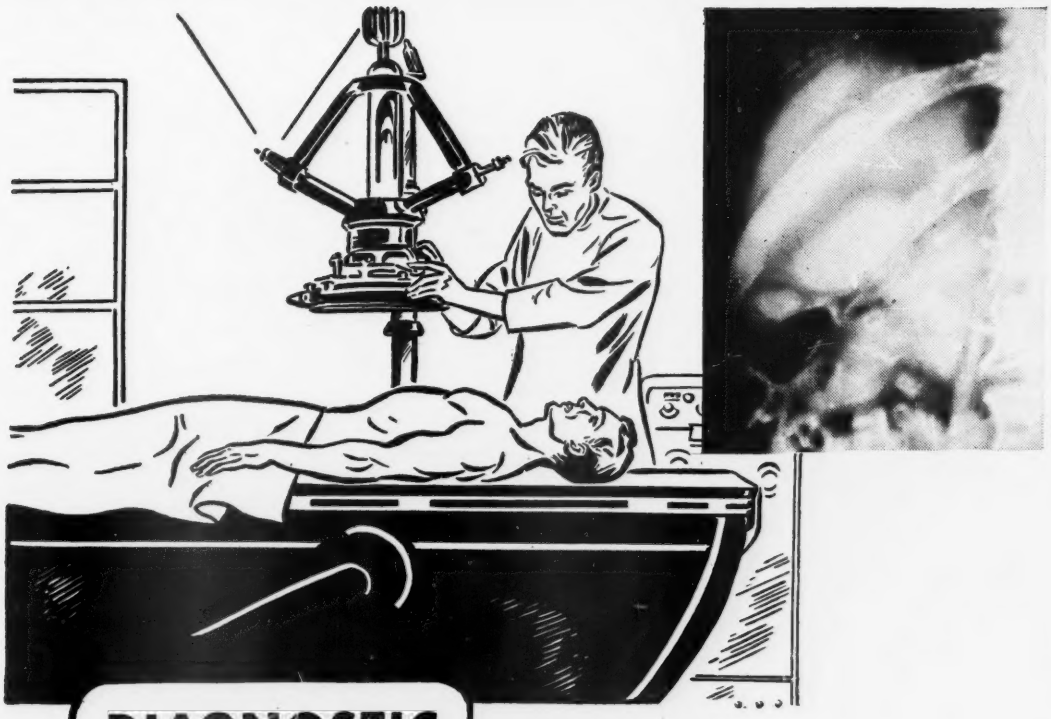

# DIAGNOSTIC ACCURACY WITH UNSURPASSED CONTRAST MEDIA

X-Ray diagnosis is often the indispensable guide to rational therapy. But even with the best mechanical equipment, diagnostic accuracy frequently depends upon the use of radiopaque media.

Mallinckrodt research chemists pioneered in the development of X-Ray media that are unsurpassed in quality and dependability.

### BARIUM SULFATE U. S. P. XII

for X-Ray Diagnosis—made by an exclusive Mallinckrodt process for utmost smoothness, excellent suspension, and freedom from injurious foreign substances.

### HIPPURAN* N.N.R.

(Sodium Ortho-iodohippurate) Relatively non-irritating and non-toxic for pyelography, cystography and urography.

### HIPPURAN* STERILE SOLUTION N.N.R.

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### IODEIKON*

(Iodophthalein Sodium U.S.P. XII)—Proposed by Dr. E. A. Graham and his associates and introduced by Mallinckrodt to the medical profession as an X-Ray medium for the visualization of the gall bladder.

### ISO-IODEIKON*

(Phentetiothalein Sodium N.N.R.)—This excellent X-Ray medium permits the examination of the gall bladder and the measurement of the hepatic function from a single injection of the dye.

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## MALLINCKRODT X-RAY MEDIA

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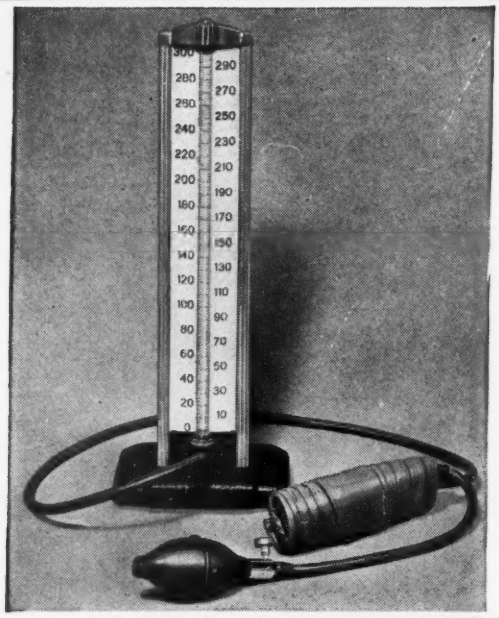
# A #5006 on your desk... looks better ...lasts longer... costs less




**B-D #5006 MANOMETER**

Constant opening and closing, wrapping and unwrapping, transferring from bag to desk to bag again — prematurely wears out Blood pressure machines.

A B-D #5006 Manometer will eliminate much of this handling. Your present portable manometer will have its life extended if reserved exclusively for bag use. Also, you avoid any possibility of discovering upon arrival at a patient's home that your dual use manometer remains on your office desk.

The B-D 5006 Manometer has no case to open and close — largely eliminating breakage and consequent danger of mercury leakage. It has no hinges or locks to require repair. The non-tip weighted base requires little desk space, permitting the instrument to be easily moved to any part of the office. The high visibility scale, registering to 300 millimeters, lends to the attractive and professional appearance of the 5006. This individually calibrated and certified mercury instrument assures constant accuracy.

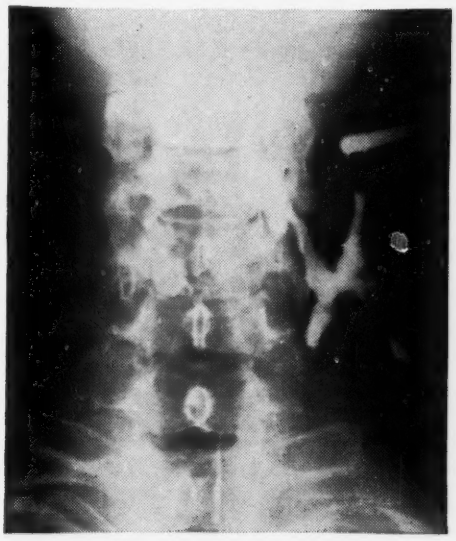
The 5006 is inexpensive. Priced at $20.00 to the physician. Ask your regularsurgical dealer to show you the B-D 5006.

B-D PRODUCTS
*Made for the Profession*

**BECTON, DICKINSON & CO., RUTHERFORD, N. J.**

# THE ADVANTAGES OF LIPIODOL DIAGNOSIS

## *In Uncommon Surgical Technics*



Unlike classical operations wherein anatomic landmarks and operative technics are well established, surgery of abnormal pathologic tracts calls for novel landmarks and individualized technical procedures. In following the strange course of such tracts, the scalpel, of necessity, must approach and by-pass vital structures. Therefore, Lipiodol renders important service in "blueprinting" the surgical field, whereby otherwise time-consuming and anxiety-producing anatomic problems become preoperatively predictable.

Specifically, Lipiodol traces, outlines, and contrasts fistulas, draining sinuses, channeled soft-tissue wounds, empyema cavities, infected cysts, and neoplasms revealing their shape, extent, ramifications, and termination. Frequently it aids in establishing an accurate preoperative diagnosis.

Presenting a bland chemical union of iodine (40%) with poppyseed oil, Lipiodol is notable for its high radiopacity, its ease of application, and its relative safety.

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## *Lipiodol* (LAFAY)

**A Reliable Aid in Roentgen Visualization of Anatomic Pathways and Cavities**

Lipiodol, made in the U. S. A., is available in a variety of ampule sizes and in 20 cc. rubber-stoppered vials.

ACCEPTED AMERICAN MEDICAL ASSN.

# To those who wonder why we need still bigger War Loans

IN THE 7th War Loan, you're being asked to lend 7 billion dollars—4 billion in E Bonds alone.

That's the biggest quota for individuals to date.

Maybe you've wondered why, when we've apparently got the Nazis pretty well cleaned up, Uncle Sam asks you to lend more money than ever before.

If you have, here are some of the answers:

### This war isn't getting any cheaper

No matter what happens to Germany—or when—the cost of the war won't decrease this year.

We're building up a whole new air force of jet-propelled planes and bigger bombers.

We're now building—even with announced reductions—enough new ships to make a fair-sized navy.

At the time this is written, our casualties are nearing the million mark in dead, missing, and wounded. Wounded men are arriving in this country at the rate of over 30,000 a month. The cost of caring for these men at the battle fronts, transporting them home, and rehabilitating them when they get here, is mounting daily.

No—this war isn't getting any cheaper. And won't for some time.

### This year—2 instead of 3

We need as much War Bond money this year as we did last. But there will be only 2 War Loans this year—instead of the 3 we had in 1944.

Each of us, therefore, must lend as much in two chunks this year as we did last year in three. That's another reason why your quota in the 7th is bigger than before.

The 7th War Loan is a challenge to every American. The goal for individuals is the highest for any war loan to date. The same goes for the E Bond goal. Find your personal quota—and make it!

THE MIGHTY 7th WAR LOAN

## ALL OUT FOR THE MIGHTY 7th WAR LOAN

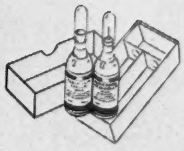
THE AMERICAN JOURNAL OF SURGERY, INC.

*This is an official U.S. Treasury advertisement—prepared under auspices of Treasury Department and War Advertising Council*

Wyeth

REG. U. S. PAT. OFF.

# PENICILLIN SODIUM WYETH



**NOW AVAILABLE IN THE WYETH VIPULE PENICILLIN PACKAGE**

**A Closed-System Unit which provides**

## *"Laboratory Fresh"* PENICILLIN SOLUTION

PENICILLIN SODIUM WYETH is prepared from carefully selected strains of certain Penicillium species. The concentrated solution of penicillin is immediately transferred to the special Wyeth VIPULE* in which it is reduced to a dry porous solid from the frozen state under high vacuum. The VIPULE is then rubber-stoppered, air-evacuated and flame-sealed.

**This form of packaging, exclusively Wyeth, provides prolonged protection for this sensitive antibiotic against air, moisture and other deleterious influences. Unbroken, the VIPULE guards the potency of the penicillin so efficiently that it remains stable for long periods of time.**

**REICHEL DIVISION**
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**PHILADELPHIA 3, PA.**

Wyeth

*REG. U. S. PAT. OFF.

**The Vipule provides a closed system technique for preparing "Laboratory Fresh" penicillin solution**

**SOLUTIONS ARE PREPARED QUICKLY WITHOUT THE AID OF A SYRINGE**

1. Snap the glass cap from the penicillin Vipule at the plainly visible etched groove. Turn down sleeve of rubber stopper over neck of Vipule.

2. Snap the glass cap from the Vipule of normal saline solution to expose the free end of the Vipule needle.

3. Invert vial portion of the Vipule with normal saline solution over the upright penicillin vial and push downward so that the ends of the needle penetrate both diaphragms.

4. "Laboratory Fresh" penicillin solution (5,000 units per cc.) is now ready to be withdrawn into a sterile syringe for administration.

## QUIETING
## THE TROUBLED WATERS

### . . . THROUGH ADEQUATE THERAPY OF THE MENOPAUSAL SYNDROME

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ORTHO PRODUCTS, INC. ▪ LINDEN, NEW JERSEY

# *hexital* (HEXESTROL-PHENOBARBITAL)

A STEP FORWARD IN MENOPAUSAL THERAPY

# The American Journal of Surgery

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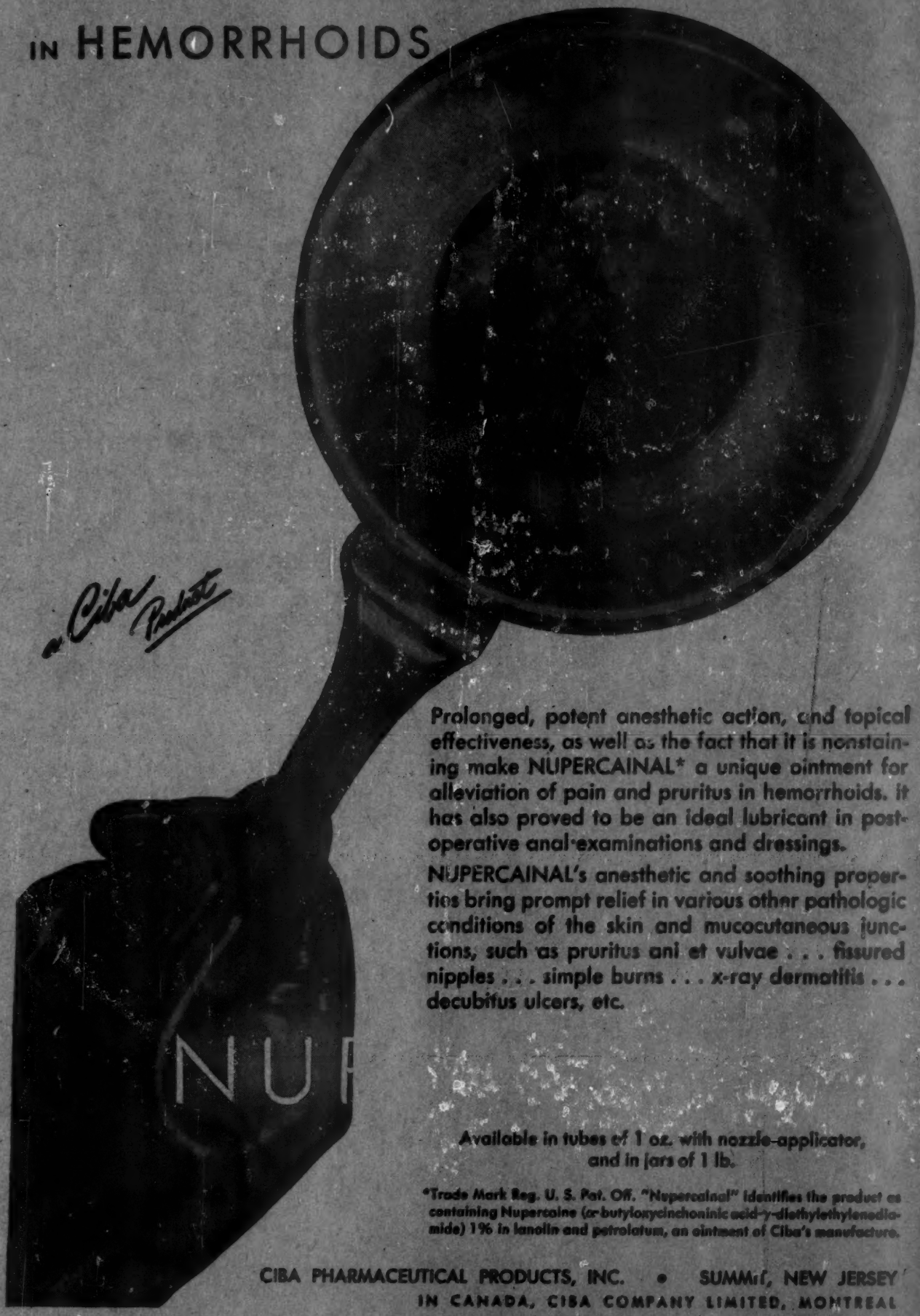
# FOR RELIEF OF PAIN AND ITCHING IN HEMORRHOIDS

a Ciba Product

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Available in tubes of 1 oz. with nozzle-applicator, and in jars of 1 lb.

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